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Money for Modernization

IT IS AN OLD STORY that recovery in the capital-goods industries, such as the manufacture of mining and milling machinery, has lagged far behind the status of food and other manufactures of consumer goods. Men must eat and be clothed in hard times as well as in good, but machines can be kept in operation even though they are obsolete and inefficient. Hence the preponderance of unemployment in the heavy manufacturing industries, and the necessity for revival there if prosperity is to return to the country.

In an effort to stimulate that revival three governmental agencies are now offering loans to industry, including mining, for capital expenditure. The rôle of the Reconstruction Finance Corporation has already been reported (*E.&M.J.*, Aug., Sept., Oct., Dec., 1934; Feb., 1935). The other two agencies are the Federal Reserve Banks and the Federal Housing Administration, the latter being the latest to enter the industrial field. Federal Reserve Banks will loan money to mining companies for modernization of plant and equipment if a clear case can be made for more efficient operation and larger profits. Applications for such loans are reviewed first by a local advisory council of business men before being passed on to the bank.

The Federal Housing Administration is not a lending agency *per se*, but is authorized to insure bank loans up to $50,000 for the purchase of industrial equipment and machinery. In this connection it is noted that the FHA encourages the employment of consulting engineers on modernization programs and regards their fees as permissible expense of such projects.

Here, then, are three sources of credit for mining companies that feel the need of modern equipment and can show that the purchase of such equipment will improve their operating and financial position. There is also an opportunity for consulting engineers to aid modernization programs by surveying mines and mills, and preparing reports to support application for loans. Finally, machinery makers themselves can promote sales by helping mining companies to take advantage of available credit. The possibilities of "modernization for profit" should be carefully investigated by all these factors in the mining industry, not only in their own interest but as a fundamental contribution to business recovery.

Futility Marks the Washington Scene

FAR from dissuading the President from carrying out his policies, the decision of the Supreme Court on NRA seems to have intensified his determination to push his entire reform program through Congress. Shorn of power to control business through codes, he immediately endorsed the Wagner labor relations bill and the Guffey coal-control bill, pressed for the enactment of legislation on social security, banking, and abolition of utility holding companies, added to confusion by recommending new tax measures aimed at great fortunes and large corporate incomes, and nursed the idea of a constitutional amendment that would centralize in the Federal Government the power to control intrastate as well as interstate business. The whole program smacks of a deep determination to gain the power necessary to re-order the business economy of the nation.

That there is a large and visible element of futility in the program is the considered judgment of competent critics, who predict that the Wagner and Guffey bills, if passed, will be fought to defeat in the Supreme Court on the ground of unconstitutionality. The validity of the social security and holding company bills is likewise held in question on the ground of imposing inequitable restrictions on special classes of individuals and corporations. But the Administration forges ahead with its program despite these prospects of defeat, in the hope of creating sentiment favorable to federal control of business. At no time has favorable consideration been accorded any of the recovery proposals of business organizations that have painstakingly formulated their ideas and presented them at the White House. The old conflict between the federal forces of reform and the business ranks of recovery is still at an *impasse* in Washington.

Galvanizing Campaign A Selling Job

FOUR AND A HALF YEARS of campaigning to increase the consumption of zinc by persuading the makers of galvanized sheets to adopt a heavier, more uniform coating, and the users of sheets to demand it, have not achieved as much as the American Zinc Institute would like. Many consumers have been taught to appreciate the value of a uniform two-ounce per square foot coating in the resultant much longer life of the sheet, and some reflection of this has been noted in the reversal of the previously downward trend of the percentage of the output of Prime Western zinc that has gone into galvanizing. Demand, nevertheless, has not risen as rapidly as had been hoped and as the superior quality of the improved product would seem to justify. Competitive materials for roofing and siding have gained or strengthened their foothold in recent years, thanks to the opportunity given their manufacturers when the galvanizers debased their product during and after the War, and this foothold has been hard to shake. Likewise, some trade practices under the Steel Code appear to have worked against the seller;

also the lack of adequate compensation for the dealer in return for having to stock an additional and somewhat higher priced grade of sheets. All of which would seem to call for correction of the practices mentioned, plus a continued and intensified effort in selling the consumer the idea that he is throwing his money away unless he buys a zinc-coated sheet good enough to last until he will no longer care when he bought it.

Miners and smelters of zinc have something at stake in such a campaign, as well as the fabricator. The degree of their immediate interest may vary with their geographic location, but anything that affects the sale of a particular metal is likely to touch every producer of that metal before it has spent its influence. Especially should the producers be interested who have the largest part in supplying the galvanizers. In the face of the situation, one would expect that those who are for pressing the lagging campaign more vigorously will have no difficulty in securing the needed financial support. To sell such an idea as it should be sold will necessitate the raising of additional funds. Future profit requires present expenditure. Industry that lives but from day to day may suffer any day. Stabilized industry thrives now on continued efforts that were begun long ago. For the future well-being of the zinc producers, the sooner their efforts are renewed and strengthened the better.

Scrap and Secondary Metals Need Statistical Study

OUTSTANDING among the projects that deserve economic analysis, from the standpoint of both resources and utilization, is the study of available scrap and economic application of secondary metals. Such a project, though dealing to some extent with resources, lies altogether in the field of economic inquiry to be made by the Bureau of Mines. The resources are, in other words, those of industry, not of natural occurrence.

In view of the fact that by planned investigation of secondary-metal supplies the United States can probably significantly stabilize price and to a great extent eliminate cause for international friction, this project takes on greater political significance than almost any other. Whether these studies are undertaken or not, the influence to which they would relate will continue to be important.

We are pleased to note, therefore, that a field survey of scrap-metal and secondary-metal production will be undertaken on an elaborate scale if proposals made to the Government are approved as a part of white-collar work relief. This study would be an elaboration of the investigations described last month in *Engineering and Mining Journal* (page 299) as a part of the projected Bureau of Mines investigations. The work would, however, be done on a much larger scale, and almost altogether in the field, if this new plan carries out.

It is contemplated, moreover, that this study would form merely a beginning of the continuing inquiry of the Bureau described last month. Such an inquiry would be strictly fact finding in nature. When policy making starts, this would be done by others than the Bureau of Mines, presumably first in the form of recommendations made by the Planning Committee for Mineral Policy.

These truths have been emphasized many times previously in *Engineering and Mining Journal,* and they cannot be too strongly nor too frequently reiterated when one is dealing with questions of mineral economy. Even those who may not be altogether pleased with the facts may, under these circumstances, wish to press for the furtherance of such studies. Unpleasant conditions disclosed may represent the best safeguard against dangerous neglect of inevitable trend. On this theory Washington will not be surprised if pressure is brought to bear for further study of secondary supplies, particularly of the deficiency metals.

Silicosis Compensation In New York State

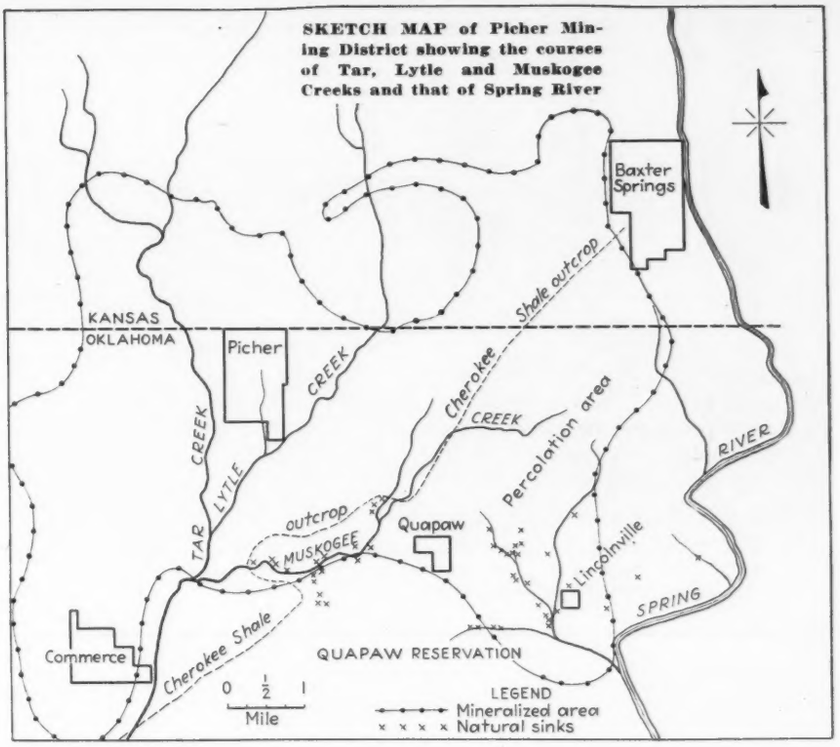
WITH the Governor's veto of a bill passed by the New York Legislature providing special schedules of limited compensation for employees suffering from silicosis and other dust diseases, these disabilities are now automatically covered in New York by the all-inclusive occupational disease amendment of the Workmen's Compensation Law. Thus the status of employers and employees is clearly defined with reference to industries and occupations involving silica and other dust hazards. The effective date of the amendment is September 1, 1935.

There has been considerable speculation on the cost of compensation insurance under the amendment and some talk about drastic increases in premiums to cover the additional risks. On this point the Industrial Commissioner says that past experience in New York and in other States having all-inclusive occupational disease coverage indicates that the new amendment will add less than 2 per cent, and perhaps less than 1 per cent, to the insurance cost of workmen's compensation. In this he is supported by Wisconsin experience, where the cost of occupational disease coverage for fourteen years was materially less than 2 per cent of the entire cost of workmen's compensation. In 1934 the number of awards for all occupational diseases in New York was only seven-tenths of 1 per cent of the total, and the money value only eight-tenths of 1 per cent of the total amount awarded.

Of course New York is predominantly an industrial and not a mining State, and its experience may not be wholly applicable where underground mining is the major industry contributing to silicosis. Nevertheless, a good example has been set. In the lead-zinc mines in the northern part of the State dust prevention in drilling and mucking has received close attention, with marked success in minimizing the hazard.

Prevention is the crux of the matter, as previously emphasized in a series of articles in *Engineering and Mining Journal.* The sooner such measures are adopted the better, because legislation on the subject is inevitable, and the mining industry should be prepared in advance to meet the issue at the lowest possible cost. Legislation, moreover, by clarifying the status of employers and employees with respect to silicosis, will afford welcome relief from the racket of civil suits that now harass industry without insuring justice to either party.

Tri-State Flood Control Cuts Mine Pumping



SKETCH MAP of Picher Mining District showing the courses of Tar, Lytle and Muskogee Creeks and that of Spring River

Measures to keep surface water and flow from abandoned wells out of underground workings are proving effective

Work done by U. S. Geological Survey with PWA funds a boon to zinc-lead district

Successful completion of project should lower cost of producing concentrates . . . improve health conditions through draining stagnant ponds . . . safeguard local water supply

E. W. McCuskey
Assistant Engineer,
U. S. Geological Survey

MINE OPERATORS in the Tri-State zinc and lead district have been compelled to maintain and operate extensive pumping facilities, at considerable expense, to hold the subsurface water level below the ore-bearing formation. This formation is honeycombed with old and new workings, and over large areas these openings are interconnected. Drainage from one shaft into another has greatly increased as a result of the premature closing of mines due to unfavorable market conditions and heavy pumping expenses. In certain areas all the mines are flooded, and the heavy expense entailed in unwatering necessitates cooperative pumping and measures for flood control.

A comparison of the number of gallons pumped in the Picher district of Oklahoma and the number of tons of lead and zinc concentrates produced for the 5-year period 1928-32 shows a fairly constant ratio. Calculations indicate that for this period the average annual pumping expense for the mines of the district was about $130,000.

In the Picher area during 1929 the precipitation was 10 per cent above normal. The records show that 22 in., or about one-half the total, fell during April, May, and June. This was a period of disastrous mine flooding. It is estimated that 10,040,000,000 gal. of water was pumped from the mines in the district that year, an increase of 24 per cent in gallons pumped as against a 2 per cent increase in the volume of production.

Several hundred thousand dollars was expended by the Quapaw Mining Corporation and its predecessors in attempting to unwater the Quapaw area, in the eastern part of the Picher district. The work finally succeeded, but only after carrying out a systematic flood-control program that consisted of plugging drill holes, diking sink holes, and cementing creek channels. Largely because of unfavorable market conditions, mining operations were discontinued in this area in 1932, and the mines were again permitted to fill with water. The company's work for the control of surface water has proved to be insufficient to afford permanent relief from mine flooding.

Mining operations and pumping in the district are carried on at progres-

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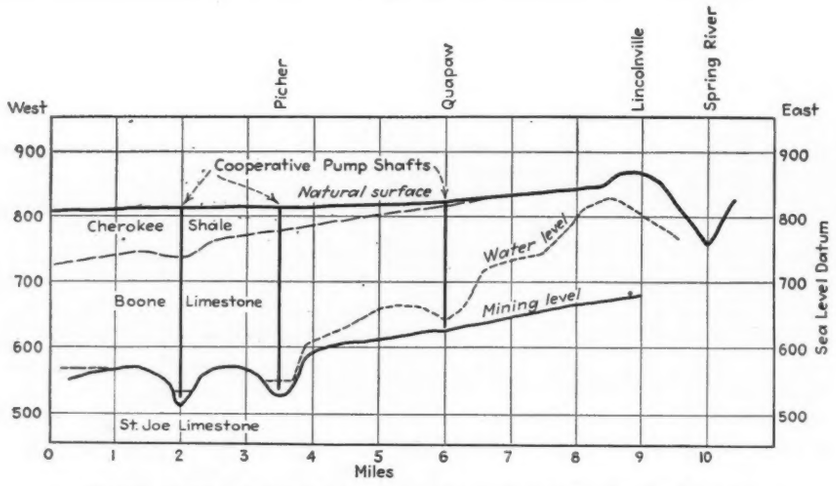
NATURAL SINK that opened during extensive overflow on March 12, 1935. The mines on this and adjacent properties were flooded. This view was taken after the surface water level had lowered 18 in.

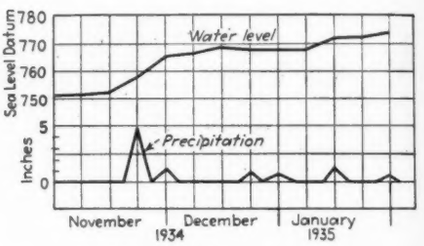


GENERALIZED SECTION showing relative elevations of natural surface, bottom of Cherokee shale, underground water and the mining level in the Picher district. April, 1935

MINE SHAFT after sealing with removable concrete bulkhead. Many such shafts have been similarly sealed in the district. Flood view taken after surface water had fallen 18 in.

sively deeper levels from east to west, following the westward dip of the mineralized formations. The water level, for the same reason, is higher in the Quapaw area than in the Picher area, and the natural underground drainage flows in a westerly direction from a high point east of Quapaw to the deepest workings southwest of Picher. This trend of the subsurface water has led to a belief by some operators that the source of the underground water in the district is the Spring River, which flows a few miles east of the Quapaw area. However, a survey of subsurface water levels in the Quapaw-Lincolnville district through a period of several months showed that the normal ground-water level in the district is 30 to 60 ft. above the Spring River. These relations are shown in the graph in the left center.

The mine water comes chiefly from the precipitation upon the surface of the mining district, but some comes from defective artesian wells. The surface water enters the mines through natural sinks (photo 1), open drill holes, open mine shafts (photo 2), and by percolation through the loose boulder and



RELATIONSHIP between precipitation and the mean mine water elevations as taken in the Quapaw-Lincolnville area. Water measurements taken in five shafts

clay formation that occupies an extensive area east of the outcrop of Cherokee shale (Pennsylvanian) in the Quapaw-Lincolnville area of the Picher district. Serious mine flooding through drill holes and mine shafts has occurred frequently during heavy rains, when streams choked with mill tailings overflowed.

It is evident that any control measures that will effect a substantial reduction in the volume of water that must be pumped to permit mining operations will reduce the cost per ton of concentrates produced and thereby make possible the mining of ore of lower grade.

The Public Works Administration has allotted funds to the United States Geological Survey for conservation work in the Quapaw Indian Reservation in northeastern Oklahoma, permitting the safeguarding of mine openings (see *Engineering and Mining Journal*, May, 1934) and the control of surface and subsurface waters entering workings of mines on restricted Indian lands

operated under its supervision. This work was started in September, 1933. It has covered several phases of mineral conservation work, such as filling or bulkheading open mine shafts, filling or plugging drill holes subject to flooding, and surface and subsurface flood-control work, including closing of sink holes to surface water, plugging abandoned artesian wells, and improving drainage channels.

Numerous natural sinks located in or near the drainage channels in the Quapaw-Lincolnville area and the southern part of the Picher area long have been carrying surface water into the mines. Mine operators state that muddy surface water has appeared in the mine sumps immediately after heavy rainfall. The smaller graph on p. 320 shows that in 1934 the water level in the mines, after having remained nearly constant for about two rainless months, rose abruptly with the precipitation which began late in November. Sinks open up along the fractures in the rock that largely control the course of drainage. A study of the sinks in this district leads to the conclusion that at least 25 per cent of the run-off from rainfall in the tributary area, about 14 square miles, has flowed into the mines. Several methods were employed in closing these sink holes to surface water, including diking (photo 3), creek-channel diversion, and construction of reinforced-concrete flumes over the openings referred to.

Thirteen abandoned artesian wells have been plugged and cemented, plugs being set in the tight formations below the mining level and at the surface. These abandoned deep wells were drilled to supply water from the Rubidoux sandstone, which is penetrated at a depth of about 1,000 ft. Prior to about 1913 these wells flowed, but as the use of the flowing artesian water was extended, the head decreased, and the water now stands from 200 to 250 ft. below the surface. It has been found that the acid carried in the circulating mine waters reacted chemically on the iron casings of the wells, in many of them causing complete failure of the casing at the mining level. This corrosion of the casings permitted the flow of artesian water into the mines.

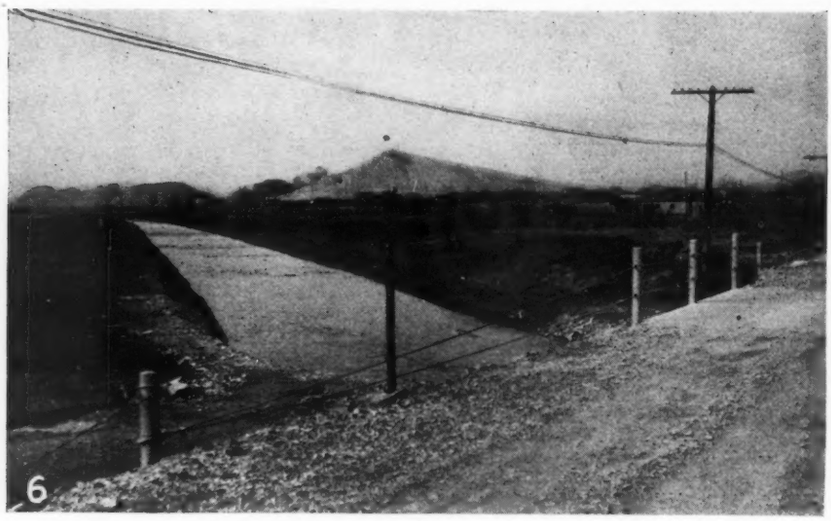
The plugging of these wells will effect a considerable saving in pumping expense to operators, and the artesian-water supply of the district, which has been lowered at a rate of about 15 ft. a year, will be conserved to an appreciable extent. A further benefit is the safeguarding of the quality of the water. The continued depletion of the artesian supply has lowered the artesian head in some areas to a point below the level of mine water, and failure to plug or replace the deteriorated well casings might have permitted the flow of contaminated mine waters into the artesian-water supply.

The channels of the three major

LEVEE, protected by riprap, surrounding open sink. Such sinks are numerous in or near drainage channels in some areas and have admitted much surface water into the mines

TYPICAL OBSTRUCTION on Lytle Creek. At this location the old channel has been completely filled with tailings from the mills and the stream flow line has been raised 8 ft.

LYTLE CREEK during extensive flood on March 12, 1935. The two shafts that are seen in the background were overflowed and carried surface water into the mine workings



AFTER CONSTRUCTION of channel on Lytle Creek. The flow line was lowered 7 ft., and a concrete spillway was replaced with a reinforced-concrete bridge

creeks that flow through the congested Picher district, Tar, Lytle, and Muskogee creeks, have been completely choked for several years by mill tailings and slime. The area drained by these creeks is about 24,000 acres, and the volume of surface water flowing through the mining district during a year of normal rainfall is estimated to be more than 30,000,000,000 gal. In addition to this surface drainage, an average of 6,000,000,000 gal. a year is pumped from the mines into these streams. Because of the obstruction of their channels (photo 4) the creeks have not been able to carry the run-off from heavy rainfall, and extensive surface overflowing has resulted (photo 5). Consequently, several open mine shafts and numerous drill holes have, in the past, carried surface flood water into the mines. Even at normal water stages a considerable amount of surface water, some of it pumped from the mines, has entered drill holes and sinks covered by ponds formed as a consequence of channel obstruction.

The objective of the surface flood-control work undertaken by the Geological Survey on Tar, Lytle, and Muskogee creeks is to provide channels of adequate waterway to prevent overflow into immediately adjacent surface openings during heavy rainfall (photo 6). In some sections of these streams it has been possible to deepen and widen the old channel, but in most places it has been found advisable to construct a new channel entirely away from the old one, thereby eliminating sharp bends, shortening the line of flow, and increasing the rate of fall.

In addition to its value to the mines this creek work is beneficial to residents in the Picher district in many other ways. Health and living conditions are improved through the draining of stagnant ponds, the water level in most places having been lowered from 4 to 7 ft. The possibility of the recurrence of serious flooding of homes and gardens in the creek basins has been reduced. Highway maintenance costs are reduced, and several roads in the vicinity of the creeks that previously have been flooded and impassable during heavy rains will remain open to traffic.

The efficacy of the portion of the surface flood-control work already completed was definitely proved after unusually heavy rainfall on March 11 and 12, 1935. The soil was saturated with moisture from the unusually heavy precipitation of the preceding winter, thus inducing a rapid run-off of this rainfall, which was officially reported as 5.28 in. for a 30-hour period. The 3-mile section of Tar Creek that had been completed through the mining district in Oklahoma to the Kansas line carried the flood waters without overflow (photo 7). But along the part of Tar Creek in Kansas which is obstructed by dams and mill tailings and in a condition similar to that which existed in Oklahoma prior to the flood-control work, the creek overflowed and mines were flooded through surface openings. During the same storm the channel of the 1-mile section of Lytle Creek that had been completed carried the flood water without overflow, but in the 2½-mile stretch extending upstream from the completed work this creek and its tributaries overflowed, with resulting major flood conditions in a congested mining area. Five abandoned mine shafts previously sealed by the Geological Survey with concrete bulkheads were covered with water; three open mine shafts were flooded; fifteen shafts that were surrounded by the overflow allowed water to flow through the soil and cribbing into the mines; and numerous drill holes permitted seepage from the overflow to enter the mines.

The effectiveness of the flood-control work was demonstrated by the fact that in the area covered by the project none of the mines was flooded.

This project of the United States Geological Survey is under the general supervision of H. I. Smith, chief of the mining division, with C. F. Williams, district mining supervisor, directly in charge of the work. Foremen employed have included J. A. Huntsinger, A. J. Kyte, and E. A. Robinson.

The author is indebted to Messrs. M. D. Harbaugh, of Miami, Okla., and R. J. Stroup, of Baxter Springs, Kan., for criticisms and suggestions in the preparation of this article.

TAR CREEK'S completed channel carrying flood waters on March 12, 1935, without overflow. The volume of flow in this instance is estimated to be more than 900,000 gal. a minute

The Panner's Rôle in Placer Drilling

J. J. Bach
Fairbanks, Alaska

MUCH responsibility rests upon the drilling crew testing placer ground preparatory to exploitation, for their findings determine the success or failure of the property. Depending upon the nature of the ground, the drilling machinery employed varies from simple hand drills to power-driven drills of the churn-drill type. Larger companies, especially those operating in northern areas, such as Alaska, where known auriferous gravel deposits are available, have adopted the churn drill as standard drilling equipment.

The crew for each drill usually consists of three men: the driller, who has charge of the operation of the drill; the panner, whose duties are to maintain an accurate log of the progress of the hole and ascertain the values taken from it; and the helper, who assists both the driller and the panner. One might say that the panner is the overseer or the one in charge of operation as each hole progresses. His duty is to see that the drill is set up at the proper location, as designated by a stake set out by surveyors. If the location is physically impossible, he is the one who determines the offset from the drill line and instructs the driller to move accordingly.

In Alaska, where some perpetually frozen ground is encountered, the panner will find that a helpful procedure is to have an ample supply of hot water available for the driller as soon as the hole is started. Obviously, faster progress can be made through the frozen muck and gravel by drilling with hot water, and the panner will also find that the material pumped from the hole will be more disintegrated and easier to handle. The panner assists the driller when not engaged. This is especially true when the hole is started and the first few lengths of casing are lowered into place. If the hole is in thawed or partly thawed ground, the general practice is to drill a hole sufficiently deep so as to accommodate the shoe length, after which additional lengths of casing are attached and driven. The first 30 ft. of a casing hole, if it is to be a deep one, are all-important, for if the hole is not started straight, innumerable difficulties will develop. Here the panner must assist, and, if necessary, wedges may be driven to keep the casing straight. Often a heavy, long pole, such as a trimmed spruce tree, can be used to advantage as a pry while the casing is being driven.

Where deep frozen ground is encountered, the best practice is to drill ahead from 40 to 60 ft., unless gravel is struck before such a depth is reached, which is followed by lowering the casing into the hole by means of an elevator clamp. Often, the first few lengths are handled with the sand line, after which the drill line is used to provide for the greater weight of the pipe as it is lengthened. While the casing is being lowered or driven into barren overburden, usually referred to as "muck," the panner is busy arranging his equipment in order to have everything in readiness for panning when the top of the gravel is struck.

If the gravel has a depth of 10 ft. or more, the panner will find that considerable time and effort can be saved by setting up a panning table large enough to accommodate two ordinary washtubs and a volume bucket in which the gravel is washed and measured. This table can be made of rough lumber and should be from 28 to 30 in. from the ground. A width of 24 in. and a length of 60 in. is ample. In rough country, where the soil is soggy, a desirable arrangement is to have a platform alongside the panning table. This platform can be made of two or three boards with cross braces, and if made of equal dimensions with the top of the panning table, it can be placed upon the table and moved conjointly from hole to hole.

Helpful hints that may increase the efficiency of the crew and promote greater accuracy in sampling

Accuracy and care are the watchwords which the panner must live up to in panning, as well as in the handling of the auriferous material pumped from the hole. Before the dump box is brought into use, the muck pumped from the hole can be emptied from the bailer by jackknifing it over a tie. By this method the sludge is run off into a shallow trench dug along the natural drainage. If the grade is sufficient, the trench can be dug as before, and a stout stick driven into the ground with about 10 in. left protruding. The pump is then lowered upon this peg, which opens the valve, and the contents of the pump are discharged into the trough. In sub-zero weather, when trenching of the ground is difficult, the peg can be driven into the head of an old sluice box and the material run off in this manner. Where timber is available, the panner will often cut two long spruce or birch poles and place them parallel on the ground to form the confining sides of the improvised ditch. After a few pumpings, the sides become iced and a serviceable drainage is effected.

The dump box, often referred to as mud trough, should be set up as though it were integral with the volume bucket into which it empties. Here again care must be exercised that no loss of values occurs through spillage or splashing. Consequently, the volume bucket is set upon a level platform placed directly under the lip of the dump box to catch the smallest particles of material emptied into the trough. After the contents of the volume bucket have been properly slimed and washed, the gravel is carefully measured and the findings are recorded on the field log.

Panning is the next step. It is an art in itself, and the one who can extract even the finest colors is worthy of the name—panner. After the colors have been counted and the weight has been estimated in milligrams, the panner enters his findings on the log, as well as the character of material encountered as the hole progresses. Beyond this, the panner's duties are purely mechanical. Suffice it to say that sample jars should be provided for all gold extracted from the hole. These jars should be properly labeled, giving the line and number of the hole and from what depths the values were taken. Special samples are necessary for "reamings" or in instances where exceptionally rich ground is encountered.

Some engineers require that a distinction be made between "casing samples" and "open-hole" samples. After the casing has been driven into bedrock a few feet and the values have sufficiently diminished, one customarily proceeds "open." Up to this time the hole has been "cased" so that a true sample of the ground is obtained. The hole then continues open for several feet, the bedrock itself forming the walls of the hole. Panning proceeds until the drill reaches a solid unstained formation, which, in all probability, is the true bedrock of the locality. Then, and only then, is the hole "called off."

Samples and log are promptly turned over to the engineer in charge, the casing is pulled by means of a top-puller or spear, and the crew prepares to move to a new location to begin another hole.

A Higher Status For Engineers

Their council for professional development seeks to achieve this through raising standards of education and practice and handling technical, social, and economic problems more effectively—In this organization seven bodies function jointly.

C. F. Hirshfeld

Chairman, Engineers Council for Professional Development and Chief Research Engineer, Detroit Edison Company

GENERAL RECOGNITION of two facts, namely, that the time has arrived when engineering must take its place among the learned professions, and that the engineer must prepare himself for a greater degree of usefulness if he is to measure up to the demands that the present social structure is preparing to make upon him, led to the organization of the Engineers' Council for Professional Development in October, 1932. Thus it is a comparatively new agency of the engineering profession.

Enhancement of the professional status of the engineer is the purpose of the Council. It aims to coordinate and promote aspirations and efforts directed toward higher standards of education and practice, greater solidarity of the profession and greater effectiveness in dealing with technical, social and economic problems.

Necessarily, this Council is a joint body because the purposes for which it was formed could not conceivably be achieved except through the most intense and sympathetic cooperation of national organizations representing several different interests in the profession. It consists of 21 members, three appointed from each of seven participating bodies:

- American Society of Civil Engineers
- American Institute of Mining and Metallurgical Engineers
- The American Society of Mechanical Engineers
- American Institute of Electrical Engineers
- American Institute of Chemical Engineers
- Society for the Promotion of Engineering Education
- National Council of State Boards of Engineering Examiners

The five first named, it is thought, represent adequately the major branches of the practice of engineering. The sixth obviously represents the educational interests. The seventh, a national organization formed by members of the boards set up by the different States for the registration of engineers, is obviously a necessary participant, since it represents the profession's increasingly important legal aspect and legal responsibility. In growing numbers the States are enacting laws to give professional status to engineers meeting certain requirements with respect to education, accomplishment and character.

Council Members Appointed

The Council is not a self-continuing nor an independently acting organization. Members are appointed by the seven participating bodies so that the latter always have it in their power to make its membership what they will. Further, it functions by studying questions within the range of its objectives and making recommendations to the governing boards of its sponsor bodies. Such recommendations are with respect to activities or procedures that it considers would be of value in enhancing the professional status of the engineer. It has no authority to undertake more than this unless specifically authorized to do so by those who formed it. Nor does it have authority to administer recommended procedures unless these have been approved by the governing boards of the participating societies and then specifically assigned to E.C.P.D. for administration.

Enhancement of the professional status of the engineer is a most intangible sort of thing. This very intangibility gives rise to many different views of the methods that might be pursued. The Council has taken the view that the soundest procedure is for the engineer so to improve himself and his capacity for service that he certainly will measure up to any demands that society may find it necessary or desirable to make upon him. It believes that the ability to serve adequately in professional capacity is bound to bring adequate professional recognition.

Such ideas make possible the preparation of a very definite program. Parts of this program already have been submitted to the governing boards of the participating societies; some of these have been approved and are now active projects.

Start was made by the Council by appointing four subcommittees, each charged with the study of a certain field of endeavor with instructions to report back to the Council. These subcommittees are:

- The Committee on Student Selection and Guidance
- The Committee on Engineering Schools
- The Committee on Professional Training
- The Committee on Professional Recognition

With the explanation that student selection and guidance refers to the entry to colleges of engineering, it becomes obvious that these subcommittees cover the entire span from the time the boy considers seriously his entry into a college of engineering until he has reached the full stature of a professional man.

The committee first named is under the chairmanship of Dean R. L. Sackett, Pennsylvania State College. Its function is to report to E.C.P.D. schemes for the educational and vocational orientation of young men with respect to the characteristics of an engineering education and the responsibilities and opportunities of engineers, in order that only those who have the high qualities, apti-

A statement presented May 20, 1935 at a meeting of the Boards of the Founder Societies and Joint Functional Organizations, Engineers' Club, New York.

tude and capacity required to obtain intellectual satisfaction therefrom may seek entrance to such courses.

The Committee on Engineering Schools is headed by Dr. Karl T. Compton, president Massachusetts Institute of Technology. Its function is to report to E.C.P.D. means for bringing about greater and more effective cooperation between the engineering profession and the engineering schools as well as to report criteria for colleges of engineering which will insure to their graduates sound educational foundations for the practice of engineering.

The Committee on Professional Training is under the chairmanship of General R. I. Rees, assistant vice-president, American Telephone & Telegraph Company. Its duty is to report to E.C.P.D. plans for the further personal and professional development of young engineering graduates and young men who are entering the profession without formal scholastic training.

The last of the subcommittees is headed by Conrad N. Lauer, president Philadelphia Gas Works. Its function is to report to the Council methods whereby engineers who have not suitable standards may receive corresponding professional recognition.

All the subcommittees have already made reports to E.C.P.D. and the latter, as a result, has already made a number of definite recommendations of a constructive nature to the governing boards of the sponsor bodies. Some of these recommendations have received favorable action, others still are before one or more of the boards for consideration.

Achievement and Failure

The engineer has done a marvelous technical job. He has in a comparatively short space of time converted the abstract findings of scientists to the practical use of man in an astounding profusion of technical inventions and their materialistic embodiments. He has, in fact, completely changed the tenor of human work and life.

But the engineer has failed to take proper cognizance of the social and economic results of his works. He appears, in most cases, to have been content to devise and execute in an altruistic spirit those material improvements which now stand to his credit without giving thought to the less materialistic but equally real problems that he was bringing into being. If he gave any thought to such matters at all, he appears to have believed that others would take care of them as their share, provided he took care of his.

It now appears that we have failed to preserve a proper balance between inventions of two radically different sorts. Inventions in science and its application appear to have outstripped inventions of social and economic types. And we shall have to make real efforts toward the restoration of a more nearly perfect balance if the works of the engineer are not to prove of less real value to the race than he has fondly hoped.

E.C.P.D. does not have any inflated notion of the engineer's abilities outside the technical field; but it does believe that the engineer is best able to interpret his own works. And it does believe that, if properly educated in extra-technical subjects, he can be of great assistance to those normally expected to make the social and economic inventions now so sorely needed. It does believe that the time has arrived when the engineer must expand the field of his activities while remaining technically sound and while continuing to consider the planning and execution of engineering works as his primary job.

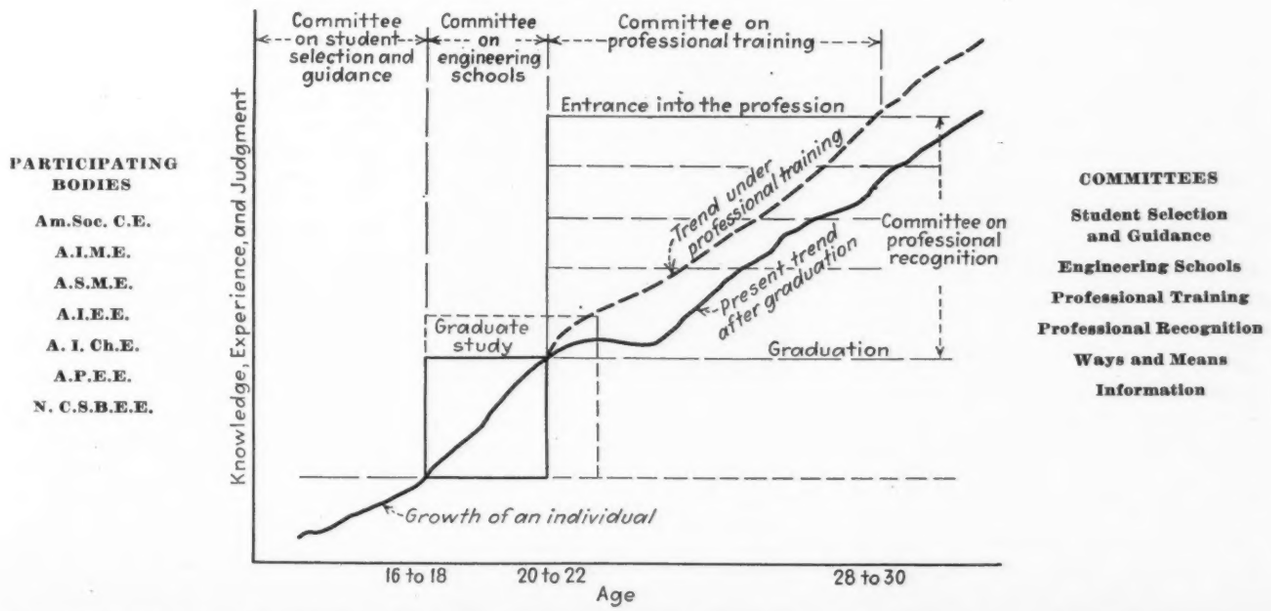
The program of E.C.P.D. therefore visualizes the production of an engineer of much greater breadth of vision than has been customary in the past. It stands for the soundest sort of training in technical matters but aims at the same time to develop that broad appreciation of human problems that it feels necessary in the engineer of the future. By such a route it sees the engineer growing to full professional status and to full recognition as a professional man.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

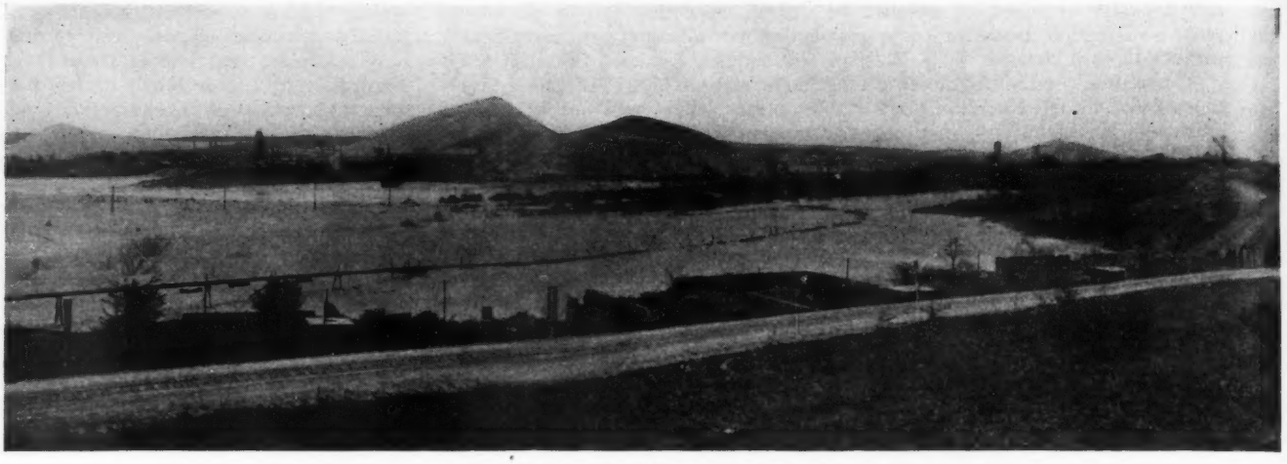
To Enhance the Status of the Engineer . . . By . . . Improving the Quality of the Engineer

THROUGH

1—Selection and Guidance of Those Who Seek to Enter Engineering Schools
2—Formulation of Criteria for Colleges of Engineering
3—Encouragement of Training of the Young Engineer of Post-College Age
4—Recognition of Engineers Who Have Met Suitable Standards



Scope of E.C.P.D. and Interrelation of Its Major Committees in the Chronology of an Engineer's Professional Development



Looking over the Flat River area in the Southeast Missouri Lead Belt. The concentrator, beyond the tailings pond, and the adjacent mine plant, which together constitute one of the several operating units of the district, are running steadily

Lead Mining Today In Southeast Missouri

AFTER five years of depression a visitor to the lead district of southeast Missouri finds the St. Joseph Lead Company operating at approximately half capacity, hoisting and milling 10,000 tons of ore a day. To maintain this level of work despite the long prevalence of a low price for lead without the assistance of any byproducts to be credited against production costs, such as many Western producers enjoy, has called for skilled management on the part of the company executives and loyal and efficient performance of duties by the staff and operating personnel. One important result is that the several communities—all of them of fair size—that are situated within the boundaries of the so-called Lead Belt have enjoyed conditions that would be welcomed in many a mining district elsewhere in the United States today. The company's present force, including salaried employees, totals about 2,400 men. It is the only operator in the district at present, the work of the St. Louis Smelting & Refining Company having been suspended.

In extent, the lead district is contained in an area approximately 12 miles long (north and south) by 10 miles wide (east and west). The company's operating headquarters are at Bonne Terre, situated in the northern part of this area, which also contains the towns of Desloge, Flat River, St. Francois, Rivermines, Elvins, and Leadwood, besides others with names less intimately connected with the present mining and milling operations. The population of the Lead Belt is about 20,000, a large part of which is dependent directly or indirectly upon the exploitation of the local natural mineral resource.

Symbols of the Lead Belt. The chat pile in the background has modified the landscape since its accumulation began and now vies with the hills and other topography. The transmission tower typifies the power through which mechanization has been accomplished, as well as the public utility, an important consumer of lead. The stream is Flat River

Many readers are doubtless aware that the lead ore of the district occurs in the Bonne Terre formation, a dolomite of middle Cambrian age and normally some 360 ft. thick. Beneath the dolomite lies the Lamotte sandstone. The deposits have been opened in the past through many shafts, most of which were collared at an elevation of 800 ft. above sea level, or not far from it, above or below. Elevations of the surface topography of the district range from 600 ft. in the river beds to 1,500 ft. on the hilltops. Surface drainage is accomplished principally through the Big River and the lesser Flat River, tributary to it, and in the southern part of the district by the St. Francois River.

Mine workings are shallow, the lower level of operations conducted over many years throughout the district having ranged from approximately 300 ft. to 500 ft. below the surface. They are wholly within the Bonne Terre formation, the lower level in cases being close to the underlying sandstone or a short distance above it.

The galena, in which form the lead

occurs, is found disseminated in the dolomite, replacing it, or at times in shale and chloritic rock; in horizontal sheets along bedding planes; in veins filling or lining the walls of joints; in openings of varying size; and in aggregates of crystal along channels. In places it occurs in bunches. Occasionally the lead is found as carbonate. The foregoing is gleaned, by way of review, partly through observation but principally from the report of H. A. Buehler, State Geologist, which, although published in 1903, is still considered adequate.

To make efficient work possible today under a program calling for 50 per cent curtailment has necessitated the adoption of a plan of staggered operation for the four units of the company—namely, the Bonne Terre, Desloge, Federal, and Leadwood units—as well as the grouping of the men into crews for operating purposes to insure to each man the agreed upon number of days or hours of work per week. The latter has been due to the company's adherence to the provisions of the Lead Code (which was still in effect at the time of writing, early in May).

Each of the four units has its mill. Under the operating plan the Bonne Terre and Desloge units alternate with the Leadwood unit, running when the latter is down, and vice versa. The Federal unit, however, runs steadily (six days per week) by virtue of the fact that it represents the consolidation of two units—namely, the Rivermines and the Federal. Up to March, 1931, these two units and Mine La Motte were in operation. In the month named, Mine La Motte was closed down, after which the Federal and Rivermines units were operated alternately until last summer, when the latter was shut down and work concentrated at the Federal. Both the Federal and Rivermines mills were built to handle the same tonnage per day, but the capacity of the former has been increased, thanks to improvement in the flowsheet and the transfer of some of the equipment from the other plant.

Mill operation is on three 8-hr. shifts, the mines on two 8-hr. shifts (from 7 a.m. to 3 p.m., and 7 p.m. to 3 a.m.), and the shops on day shift (8-hr.) only, save for a few men of various crafts who work at night to take care of such jobs as cannot be held over until the following day. Sunday operation has never been the custom in the Southeast Missouri district, either on surface or underground.

Operations are directed by the general manager, whose headquarters are at Bonne Terre, assisted by two division superintendents and assistant division superintendents, one group handling the Bonne Terre, Desloge, and Leadwood units, and the other the consolidated Federal division. Under the division heads are four mill superintendents and two mine superintendents. Save for the Bonne Terre unit, all underground workings of the company throughout the district are connected.

Viewed as a whole, the operations of the St. Joseph Lead Company afford a spectacle of mechanization carried to a completeness not equaled by any other large company in the United States that mines its metal underground, if indeed by any smaller company, which is very doubtful. This superiority with respect to mechanization is primarily due to the use of mechanical shovels for all mucking, whether in development headings or for production in stopes. Nature has favored the company in that the ore deposits so occur that they can be worked largely from one level today. The mode of ore occurrence again favors the use of mechanized mucking, in that all working places, including headings, can be and are of ample dimensions, permitting the employment of large-capacity shovels. Shaft sinking, moreover, is largely a thing of the past. Of the many shafts on the company's property four are used for hoisting ore, three for waste and five for men and supplies. Their operation is reduced to a minimum, inasmuch as the level of mining is only 400-500 ft. beneath the surface. Not only does this fact in itself lessen the work of lowering equipment and supplies, but together with the ample size of the workings and the numerous openings and the consequent excellent ventilation, it has contributed to the establishment of shops underground, both for drill and shovel repair and for sharpening steel. All this is of great benefit to mechanized operation. The working conditions described are likewise favorable on the additional score that dust from drilling, breaking, mucking, and any other cause is largely settled close to the point of origin, the part that remains suspended for a longer time being greatly diluted. Powder fume, caused by blasting, is likewise quickly dissipated.

Mechanization also manifests its completeness in drilling, for which not only have air machines long been used but also pneumatic feeding. Haulage likewise is almost completely mechanized today, electric trolley locomotives being employed with trolley-reel locomotives largely for gathering. The practice used has been developed through a gradual transition, beginning with mule haulage, and passing through intermediate stages when high-pressure compressed air locomotives and storage-battery locomotives, respectively, were employed, to the present time, when the electric locomotives of the type first mentioned have supplanted the other means of haulage, save for a small number of mules that are still used for gathering in some parts of the property.

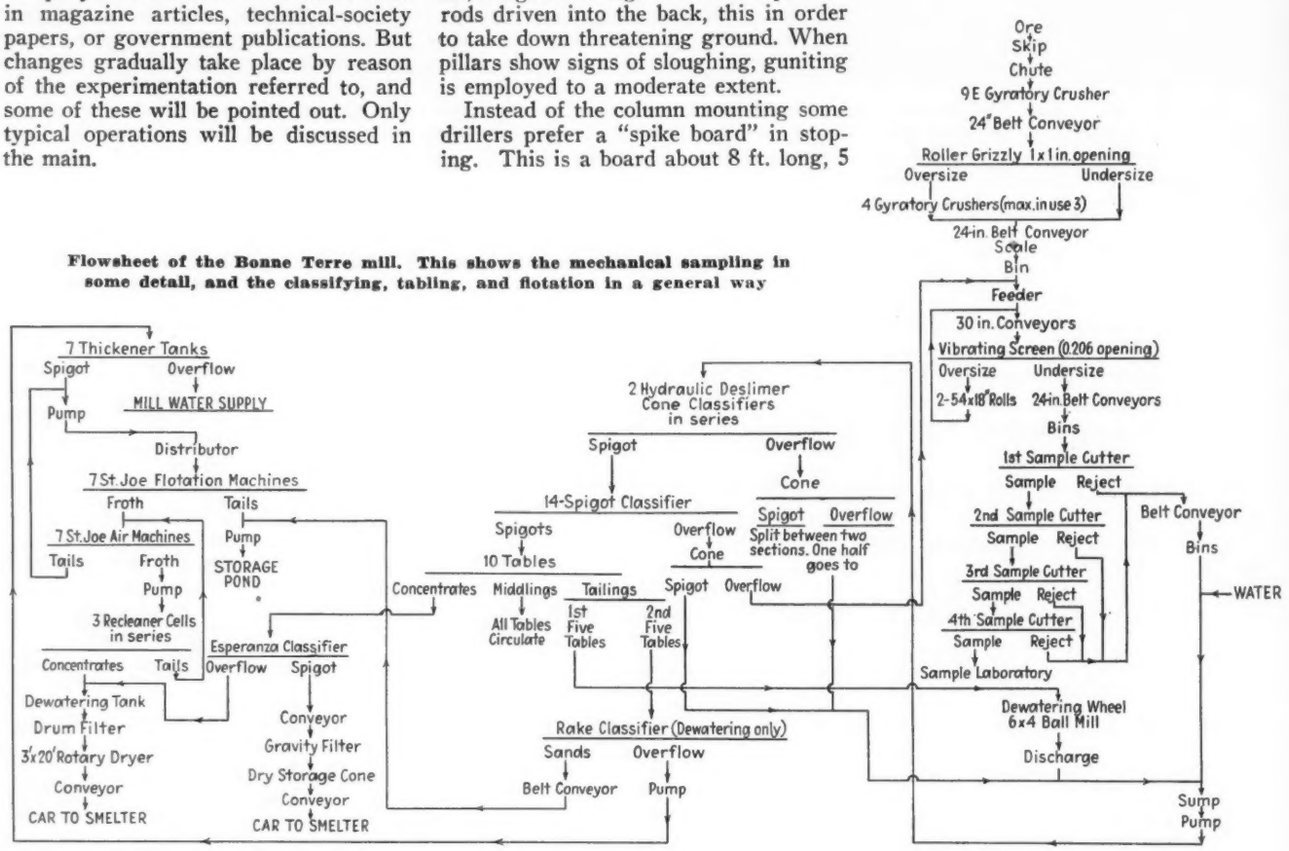
Dumping is done mechanically, rotary dumpers that take three 2½-ton main haulage cars at a time handling the entire tonnage. Hoisting has long been electrified, and self-dumping skips in the main are used, although at one shaft cars are hoisted in a self-dumping cage, affording a glimpse of a bit of interesting practice, often used by coal mines but rare elsewhere. To finish this picture of the completeness of mechanization, it is necessary to add only that all handling of ore, concentrates, and tailings on the surface is done by conveyors, feeders, and other mechanical means, save where gravity can be utilized. Despite the flat or fairly flat mill sites, elevators are used to only a limited extent.

Description in great detail is not the purpose of this article. Rather, the reader will be more interested in a general picture of what is being done today both underground and on the surface, in a district that is the principal supplier of lead in the United States. The com-

Mechanized operation and efficient management combine to maintain a fair measure of well-being for the workers of this old district

St. Joseph Lead, conservative in all things and with a payroll of 2,400 men, steadily improves its practice

pany's operations are so extensive that one is bound to find minor variations in practice from point to point underground, and likewise in the mills. Indeed, the management has made no attempt at rigid standardization, but rather has left some leeway for the heads of the different units to exercise their ingenuity in devising improvements in the practice. Thus, the risk of stifling initiative is avoided and the benefit of being able actually to try out an idea on the job is secured. At one time or the other various phases of the company's work have been dealt with in magazine articles, technical-society papers, or government publications. But changes gradually take place by reason of the experimentation referred to, and some of these will be pointed out. Only typical operations will be discussed in the main.



Flowsheet of the Bonne Terre mill. This shows the mechanical sampling in some detail, and the classifying, tabling, and flotation in a general way

To begin with extraction, open stoping with pillars is employed. No timbering is required. The method is modified according to the height of the mineralized ground. In so-called "low ground," where the back is 7 to 9 ft. high, so that the full height can be taken in a single operation, a column mounting is used, with the jackhammer drills. Three 10-ft. holes breaking to the free face suffice between floor and back, one midway and the other two under the roof and close to the floor respectively. These holes, in sets of three, will be fanned out away from the free face to break out the ground between pillars. Or the face between pillars may be advanced in a series of steps. In stoping low ground, 12-ft. pillars 22 to 30 ft. apart will be left.

In "high" ground—that is, ground between 7 to 9 ft. and 75 ft. in height—a breast 8 ft. high is carried just under the roof 22 to 30 ft. wide in the same manner as in low ground, and the resulting bench is taken out with long down holes. That part of the bench nearest the floor will be broken with 12 to 14 ft. lifters, with so-called "splitter" holes above them averaging 12 ft. long, if necessary. Pillar width increases with stope height, running up to 25 ft. in a 75-ft. stope.

Careful attention is paid to the condition of the back, especially in high stopes. If necessary, foot walks or runways are run out from the nearest pillar, hung from hanger bolts or suspension rods driven into the back, this in order to take down threatening ground. When pillars show signs of sloughing, guniting is employed to a moderate extent.

Instead of the column mounting some drillers prefer a "spike board" in stoping. This is a board about 8 ft. long, 5 in. wide, and 1½ to 2 in. thick. At one end three or four mule shoes are nailed about a foot apart, each with its two ends curled up sufficiently to hold the handle of the jackhammer. At the opposite end a single mule shoe is nailed with its ends projecting about 2 in. beyond the board and sharpened. To use this, the driller first throws a 10- or 12-ft. plank about a foot wide on the muck or floor at the same horizontal angle to the face as the holes are to be drilled. Then he sets his spike board upright, jams the sharp prongs of the lower shoe into the plank, and rests the handle of the jackhammer in whichever curled-up mule shoe is at the best height for drilling his hole. After collaring the hole, and as it deepens and the jackhammer moves closer to the face, the driller follows it by inclining the spike board more and more. If the board becomes too flat, he moves the lower pronged end along the plank nearer the face. The board is simply a device for holding the jackhammer against the face at a height that could not be reached by hand alone. It also supports the weight of the drill.

All stope drilling is dry; all drilling in development headings wet.

At the outset, reference was made to the general use of the pneumatic feed on rock drills. This has long been the company's practice. Soon after the jackhammer drill was first developed, one of the operating staff, finding it useful for block shooting and other short-hole work for which it was originally intended, devised a column mounting for it, including a pneumatic feed. The latter was secured by carrying the drill on a 2-in. tube which telescoped within a larger tube clamped to the column and capable of being set for drilling holes of any inclination. Air bypassed from the drill supply valve through a control valve into the inner tube escaped through a hole in its end into the outer casing, where it acted against the end of the inner tube as against a piston, so that the inner tube, with the drill it carried, could be fed forward as desired for a distance of about 2 ft. by means of the control valve. At the end of the run the entrapped air escaped. This pneumatic feed, essentially as developed, is still

giving effective service in the mines.

One of the most important recent changes in mining practice has been the adoption of a smaller gage for bits on the $\frac{7}{8}$-in. hex. steel, thereby resulting in drilling a smaller hole. Previous practice was to forge a $1\frac{3}{4}$-in. bit for starters and a $1\frac{1}{8}$-in. bit for finishing, dropping an eighth for every 2-ft. change in between. For these holes $1\frac{1}{8}$-in. 40 per cent gelatin was used. Now one division is starting with a 1 5/16-in. rose bit and finishing with a 1-in. double-chisel bit with 1/16-in. changes, and using $\frac{7}{8}$-in. 60 per cent gelatin. The other division has dropped its gage an eighth and is finishing with 1 in., retaining the cruciform bit and using 1-in. 60 per cent gelatin.

This adoption of a smaller hole is based on the theory that drilling speed is proportional to the work done, which in turn is proportional to the cross-sectional area of the hole, which in its turn is proportional to the square of the diameter. Incidentally, it illustrates the opportunity afforded the operating executives for improving practice.

Steel is bought in 20-ft. bars, which are sent underground, where each blacksmith cuts them to suit the occasion.

Ammonia gelatin, in the strength specified, is used for blasting, with No. 6 caps and ordinary fuse for stoping and electric delays for all development work. This powder has been found to give the least fumes and a minimum amount of poisonous gases.

Main haulage cars, loaded directly by the shovels, are of $2\frac{1}{2}$-ton rigid-body type, dumped three at a time by rotary dumpers. They are hauled by 15-ton, heavy-duty type trolley locomotives in trains of 30 to 50 cars, the distance to the dumper averaging $2\frac{1}{2}$ miles. Gathering locomotives, of the reel-trolley combination type, range from $2\frac{1}{2}$ to 8 tons in size. Main haulage track gage is 2 ft., save in one unit, where it is 30 in. Rail weight on main haulage is 56 to 75 lb.; in headings 30 lb. Rails are now being butt-welded instead of bonded, using the 275-volt d.c. trolley circuit. This has improved the conductivity. The trolley circuit returns through the rails. A block signal system is provided. A supply of dry sand for locomotives is brought underground in a 6- to 8-in. pipe.

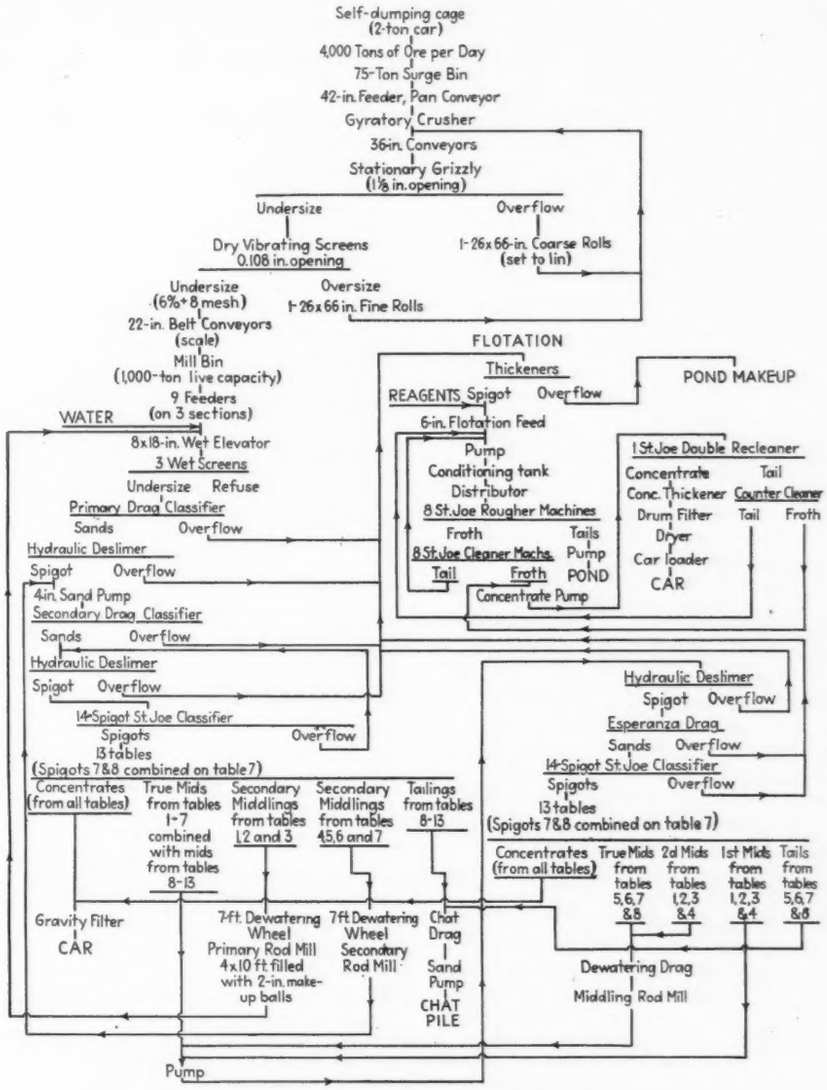
The underground shops, previously mentioned, are well equipped with hand-operated jib cranes, overhead trolleys, and the like to facilitate the transfer of heavy motors from truck or storage to locomotives or for similar tasks, especially where only one man is available. For keeping spare shovel motors stored in the underground shop, out of the damp, a dozen or so old 1-ton mine car bodies have been half buried in the floor, each being covered with a piece of steel (carbody) plate, provided with a handle. Overhead runs a hand-operated crawl. One motor is stored in each compartment thus made.

The locomotive repair shop has a concrete floor, this being easier to keep clean. A separate well-equipped electric welding and cutting shop is provided. The drill repair shop is equipped for drill-testing with respect to running qualities, including air consumption. Drill parts for individual mines are packed in stout four-compartment boxes. Parts for drills, shovels, and locomotives are charged to their respective machines. Shop roofs are whitewashed.

Not all shop work is done underground. That performed consists of repair work or the reassembling of a machine with replacement parts. Any manufacturing of new parts or the bringing of old ones up to standard size, as in resurfacing with the welding torch (which is extensively employed), is done in the surface shops. A local independent foundry makes castings from patterns furnished by the company.

By this time the highly efficient St. Joe electric shovel, used throughout the workings for all mucking, is too well known to be again described. It is of standardized design and capacity, save that some are intended for high working places and others for low headroom. The latter were originally designed for a back 7 ft. high, but actually required 8 ft. Therefore, about four years ago, the "A" frame carrying the shovel dipper was lowered and several inches cut off the lip of the dipper, and to compensate for the decrease in capacity that the latter would otherwise cause, the dipper was widened by cutting it in two with a torch and inserting a piece of steel.

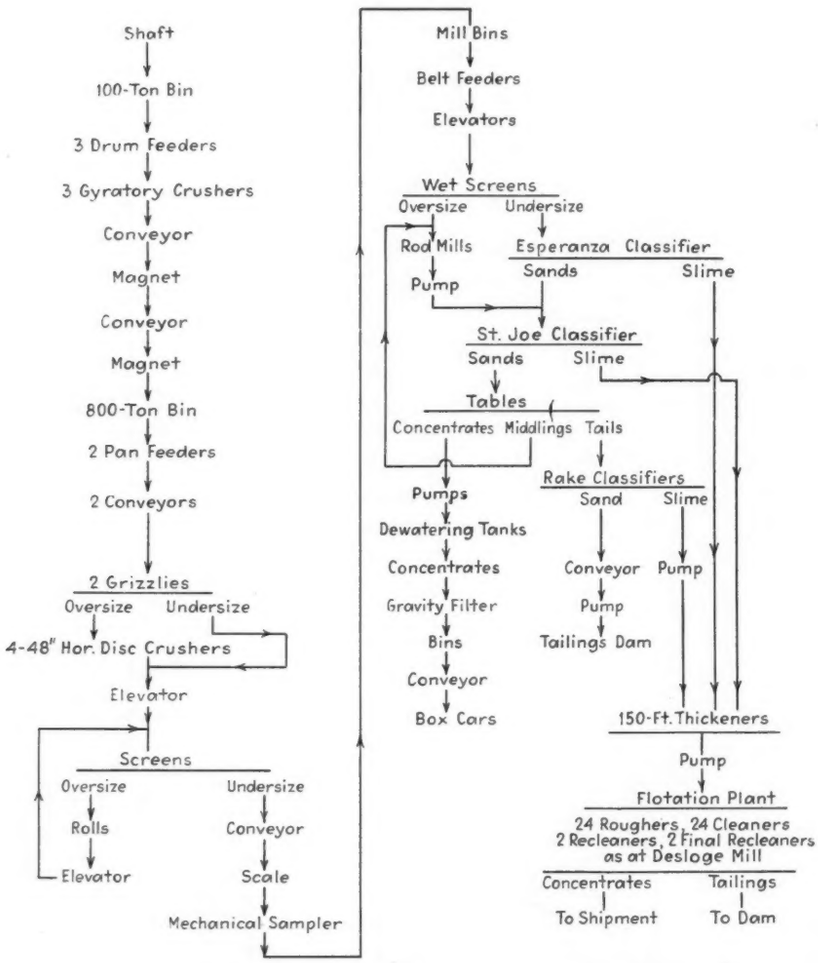
When shovels are to be moved any considerable distance through the workings they are mounted on a truck built specially for the purpose. Otherwise



Flowsheet of the Desloge mill. The classifier and table circuits are indicated in detail

they move on their own tractor treads.

In one division where the ore delivered to the dumpers comes from several different areas, in which the ground is very low and the working places are scattered, an ingenious scheme of sampling at the dumper is employed in order that a check as accurate as possible can be kept on the ore deliveries from each point. At three places on the dumper structure, one opposite each car, a device resembling two pieces of channel iron reversed to each other intercepts the ore stream falling from each car and in effect takes a grab sample.



A generalized flowsheet of the Federal mill. One of the principal points of difference here, as compared with the other mills, is the horizontal disk crushers

The first channel cuts the sample, delivers it to the second, which delivers it to a sample pail hanging below it. All this is fixed on the dumper, turning with it. After each trip has been dumped, the samples are removed, reduced in a little laboratory crusher and a pulverizer and split to laboratory size by a workman, this equipment being installed near the dumper at a convenient point.

Ore is hoisted for the most part in 2½-ton balanced self-dumping skips. One exception already noted is the self-dumping cage. Men and supplies in some cases are hoisted in separate service shafts. In one case a combination skip and cage is employed in balance for handling both ore and men in the same shaft as commonly practiced elsewhere. Hoisting depth is fairly uniform, averaging about 400 to 500 ft. Hoists are commonly electric-driven second-motion units, usually double-drum and converted from former steam-operated units. One drive is typical, consisting of a 150-hp. 440-volt, 60-cycle, 3-phase induction motor, turning 690 r.p.m. at full load. Another was similar but working on 2,200 volts. The larger installations are equipped with 500-hp. motors.

Ore is dumped directly into bins built in or adjacent to the headframe and supplying the mill handling the ore from the division or the unit.

Milling practice in the various units is fairly uniform, though differing here and there in details of treatment as well as occasionally in the type of equipment used. It is illustrated sufficiently in the accompanying flowsheets, which, it should be borne in mind, show only the practice at the moment. Changes of detail are continually in process of making. As will be noted, crushing is done in gyratories and rolls, disk crushers also being used in one instance. Vibrating screens are employed, the undersize going to ball mills (or rod mills using balls) for grinding. After classification and desliming, the resultant sized feed is tabled, and the slimes are treated by flotation in St. Joe pneumatic machines. Reagents used in a typical plant were No. 31 aerofloat and thiocarbanilid as collectors, cyanide and zinc sulphate as depressors, with lime only for thickening, and cresylic acid as a frother. The concentrates are thickened, filtered, dried, and shipped in box cars to the company's smelter at Herculaneum, Mo., some 30 miles north of Bonne Terre, and the American Smelting & Refining Company's smelter at Alton, Ill., where they are reduced to lead.

The most important metallurgical developments of recent years have been the introduction of hydraulic classification for sizing the table feed, which has been discussed briefly in a recent paper by a member of the staff, and, more recently, the severance of the responsibility for sampling from that of operation. Mill results are reported to check well with smelter returns.

The ore contains a very small amount of zinc, formerly saved but no longer. It is now depressed in flotation and passes into the tails.

As in the mines, so in the mills the visitor will notice frequent ingenious operating details. Among these was the suspension of the tramp iron magnets preceding the secondary crushers, each from an overhead motor-operated crawl, whereby each magnet can be swung momentarily out from over the feeding conveyor and the iron quickly removed.

In another instance, in one of the mills where the floor slope is ½ in. per foot, all mill spillage is picked up and returned by a 6-in. centrifugal pump to three extra tables provided in the middlings section, the result being an unusually clean plant, in this respect.

Power made at Bagnell dam is bought from the public utility company. An effort is made to control power peaks. In one case, equipment is installed to cut the power automatically from the feeders of the secondary crushing plant. Before that the control was applied to the hoist.

Several large centrifugal-type pumping units, for mine drainage, each direct-connected to 640-hp. synchronous motors, are also operated during periods between mining shifts to equalize the load conditions. Each unit has a capacity of 5,000 g.p.m. against a total head of approximately 435 ft. The volume of water pumped from the mining area ranges from 25,000,000 to 30,000,000 gallons per day of 24 hr. throughout the year, regardless of rate of operations. Pumping units are installed at each mining division.

Correcting Power Factor At Mine Plants

A means of increasing capacity without disturbing the balance of the system and at less expense than the installation of additional generators would entail

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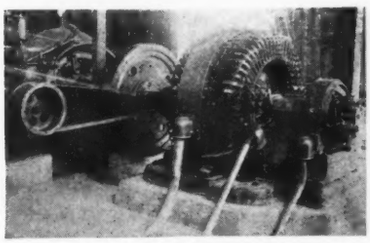

At a mining company's power plant in Ecuador

NO MINE manager signs blank checks for his steel or dynamite, but he often does the same thing, unknowingly, where his electric plant is concerned; not because of lack of interest in the power cost, but due to his greater interest in direct mining costs, forgetting that although a mine is not primarily a power producer, nevertheless an efficient electrical plant will help greatly in lowering the total mining costs and increasing the profits.

One would think that if every effort were bent toward producing power in the most efficient manner, an extremely low kilowatt-hour rate could be secured. In practice, however, such an approach to the problem usually results in a higher cost due to an increased capital investment. The most satisfactory results will be secured if the middle ground is chosen and the mine manager selects and operates his electrical plant with one eye on electrical problems and the other on the mine.

Whenever additions to the equipment of the isolated mine, which because of its location must generate its own power, are being considered, someone is sure to ask, "Where will we get the power?" The chief electrician usually throws up his hands, reminds the mine manager that the transformers (rated at a 50 deg. C. rise) are now hot enough to fry eggs and that the generators are carrying peak loads.

Perhaps the electrician's statements are true enough on the surface, but let us get down to facts. In those plants that are using direct current only, little can be done about making more power available other than to install more or larger generators and lines or to spread out the use of the power as evenly as possible. A far greater number of mines, however, are using alternating current for their power needs, and in these it may be possible to blast out large blocks of hidden power whose existence has been forgotten.

Alternating current has many advantages for mine and surface plant. It gives a flexible method of converting to any desired voltage, by means of transformers that are exceedingly efficient, for economical transmission over long distances or for any light, heat, or power need. It also enables the use of sparkless, commutatorless motors so well designed and ruggedly constructed that in the smaller sizes they may be connected directly to the line for starting, while larger motors require only a single step compensator.

Although alternating current has these advantages, it does have one fault that is often given little consideration because its importance is not realized or because of the relative difficulty of understanding it. This little catch is our forgotten friend, Power Factor. The cost of low power factor is not as easy to visualize as that of using a poor grade of steel. Every electrician has seen high voltage break down the insulation of a coil or cable; he has seen a high amperage current blow fuses or melt wires, and has seen a thousand-watt lamp burning up a kilowatt of power. Low power factor is not as evident and does no such spectacular tricks, but under the cloak of invisibility its wasteful additions to the cost of power go on unchecked for years.

Before going into a discussion of power factor a homely example may help to make it clear. Though the analogy employed may seem like an attempt at humor, it is really most apt and hard to improve upon. We shall take as our example a 10-oz. glass of beer. With the glass full to the brim we have a definite quantity of beer, but if one quarter of the glass is filled with foam, the amount of beer is only 7½ oz.; yet the price remains the same. If beer is preferred to foam, the inside of the glass can be lightly ringed with butter and the amount of foam reduced.

Changing into electrical terms, the amount of beer becomes kilowatt-hours, the relation of beer to total contents power factor, and the foam the useless reactive component, which, if corrected by means of static or synchronous condensers, corresponding to the butter ring, adds to the total available power just as replacing the foam adds to the total amount of beer.

This analogy, though simple, will help to make the relationship clear. The practical electrician will find it unnecessary to go into the theory of power factor deeply, but if he is sufficiently interested, numerous books on the subject are available.

Power in an alternating-current system can be found by the following formula: $W = V \times A \times p/f$ times a constant, which depends upon the number of phases. For single phase this is 1, for two phases 1.41, for three phases 1.73. In this formula V equals volts, A equals amperes, and p/f equals the power

factor of the system and W equals power in watts. This holds true where the load is equally divided between the phases.

Altering any one of these factors changes the amount of power obtained. Increasing one of them increases the available power accordingly. If we can increase one of the factors without disturbing the balance of the system, we can get a proportionate increase in the capacity of the plant.

Considering voltage, we can do little about increasing it, inasmuch as the insulation of the equipment and the ratings of the lamps, heaters, and motors would be affected by the increase. No increase in amperage is possible likewise, as the amperes passing through electrical apparatus govern the amount of heat generated in it, and the capacity of the equipment is limited by this heating.

As for power factor, however, inasmuch as it may be anywhere from 50 to 75 per cent, depending on the types of motors and the characteristics of the connected load, we have a factor in which improvement can be sought. When lightly loaded, induction motors operate at a low point of efficiency and are in addition a cause of low power factor. Slow-speed motors, due to inherent characteristics of design, have a lower power factor than higher-speed motors of the same horsepower.

Underloaded induction motors are the greatest single cause of low power factor, and on account of the cause the remedy is simple: loading the motors as close to capacity as is possible or safe and installing some type of capacitance to correct the remainder of the low power factor. An exhaustive series of tests conducted on motor installations in mines, mills, quarries, and manufacturing plants showed motors to be loaded as follows:

Load	Percentage of Tested Motors
Overloaded	5
85 to 100%	55
70 to 85%	25
50 to 70%	10
Less than 50%	5

These figures were gathered during the last few years from the plants of companies that wished to get their electrical equipment in the most economical and efficient condition. The most important conclusion to be derived from the figures is that the bugaboo of most electricians, overloaded motors, is seldom encountered. Badly overloaded motors announce their condition in no uncertain manner. In contrast, underloaded motors give no indication that they are even more expensive to operate because of the resulting low power factor.

The power factor of the plant can be obtained easily from the station voltmeter, ammeter, and wattmeter, if there is no direct-reading power-factor meter available. The wattmeter gives the true power being used in the plant, in kilowatts; and the ammeter reading multiplied by the voltmeter reading gives the apparent power in voltamperes, which, when divided by 1,000, gives the kilovoltamperes, or Kva. $\frac{A \times V}{1{,}000} = \text{Kva.}$

Power factor, the ratio of the true power to the apparent power, is equal to the wattmeter reading in kilowatts divided by the Kva. Power factor $= p/f = \frac{KW.}{KVA}$

Improving Power Factor

A simple method of improving power factor is to use synchronous motors on large units of continuously operating equipment such as fans, compressors, and mill drives, rather than induction motors. Not only do synchronous motors remove a source of low power factor when they are installed in place of induction motors, but they also aid in improving the power factor in the entire system.

What are the advantages of high power factor? The savings will come from the increased capacity of the present generating plant or in avoiding the need of installing more equipment. The increase in capacity involves the entire electrical plant, generators, transmission lines, and transformers.

One can easily see that if a pump is circulating a mixture consisting half of air and half of water, the capacity of the pump and pipe lines will be doubled if the air is removed. And if an electrical system is doing the same thing with an electrical current, only half of which is useful, removal of the useless part will allow that much more power to be made available.

How can this result be secured? There are several ways. The first, as already stated, is to see that all motors are fully loaded, this being done by changing motors about and using smaller motors if necessary. The second is to use synchronous motors in place of induction motors wherever possible. The last and most expensive is to install condensers. The cost of condensers has been lowered greatly in the last few years, but their installation should be carefully studied before any plans are made regarding their use.

Unfortunately, condensers are most easily and cheaply installed at the generator, where the only result is to increase the generator capacity without a corresponding increase in transmission lines. For greatest efficiency a condenser should be installed at the motor. Due to the small size and the number needed to correct the power factor, this is still quite expensive. A medium can be arrived at by installing them at the load end of the transmission lines. If large synchronous motors are used to drive compressors, these may to a great extent correct low power factor, in so far as the particular circuit to which they are connected is concerned. In very large installations it may even be found advisable to run a large synchronous motor or rotary condenser without a load for the one purpose of improving the system power factor.

In the United States, more and more attention is being paid to this aspect of electrical distribution. Some power companies have installed condenser equipment at their own cost to secure increased capacity with existing equipment.

What will this type of correction cost? Ordinarily, correction to more than 90 per cent is not feasible. If then, we take a 750-kw. plant with a power factor of 70 per cent and correct this to 90 per cent, we have added 20 per cent to the actual capacity of the generators. This is 150 kw. and at an isolated mine would cost about $10,000 to install.

There are little or no maintenance costs where static condensers are used. Synchronous condensers will require the care necessary for a motor one-third the size.

The cost of correcting our 750-kw. plant to 90 per cent will be about $4,200 plus freight and installation. Compare this figure with the cost of installing an equivalent amount of generating plant. Following are given the costs of both types of condensers for varying amounts of correction from 70 to 85 per cent, 95 per cent and 100 per cent, for a 750-kw. plant.

Static Condenser	Correction from	Synchronous Condenser
$3,000	75 to 85%	$3,500
5,000	75 to 95%	4,800
7,500	75 to 100%	6,200

At those mines that have made no previous efforts to determine the characteristics of electrical power consumption, testing equipment may not be available. Perhaps the best investment in such a case will be in a test outfit, like the Industrial Analyser, for example. Meter equipment of this kind will test motors from 5 to 200 hp. The outfit can be connected into the circuit and readings taken while the motors are on the load. The current transformers have split cores and, because of this, any motor can be tested without interfering with operation or shutting off the current. Such a testing outfit can be used by any electrician without special knowledge.

One can say that in any operation using electrical power, whether purchased or generated at the property itself, a thorough and careful investigation will show possibilities in regard to lowering costs. When the investigation is carried to completion and changes advisable have been made, one is then justified in believing that the electrical power is bought as efficiently as supplies may be purchased. Electricity is purchased as is drill steel, cyanide, power, or timber, and the same effort should be made to see that it is used properly.

Glory-Hole Surveying At Fresnillo

A Proposed Method Based on Recent Procedure at This Property, Renowned for Its Mining Practice

Right. View in the glory hole, Fresnillo, showing slopes typical of those that had to be surveyed in the earlier years. Left. Another view of the Fresnillo glory hole, showing the great depth and precipitous slopes that prevailed in later years. An idea of the size may be got from the drifts and crosscuts to be noted in the picture. The total height represented is over 400 ft.

James G. Traill

Efficiency Engineer
The Fresnillo Company
Fresnillo, Zac., Mexico

SILVER MINING at Fresnillo has been characterized since 1922 by the large-scale use of the glory-hole method of mining. Fresnillo practice in this method is justly renowned, and technical articles have appeared describing the operation. ("Fresnillo Glory-hole Mining Practice," by Thomas C. Baker. *Engineering and Mining Journal-Press,* Vol. 116, No. 22, Dec. 1, 1923. "Mining Methods and Costs at Fresnillo, Zacatecas, Mexico," by A. Livingston. United States Bureau of Mines Information Circular 6661, Nov., 1932.) From 1922 to the end of 1932, approximately 8,500,000 tons of ore and 1,500,000 tons of waste had been won by glory-holing, at an average cost for ore breaking, including secondary breaking on the grizzlies, of 21c., United States currency, per ton of ore. The result of this intensive attack is a large, impressive, irregular hole, about 700 meters long by 200 broad at its widest part, cutting in a northwest-southeast direction through the center of the Proaño hill. The maximum depth of this hole, from the top of the hill to the bottom of the excavation, is 180 meters.

Originally, the management expected that the lowest depth to which it would be possible to mine by glory-holing would be reached at a point about 15 or 20 meters above the present bottom. However, as mining proceeded downward, the engineers found that the north wall was stronger than had been expected, and would stand well at comparatively steep angles. This fortuitous circumstance enabled them to continue glory-holing beyond the previously determined limit, and a further million tons was mined by this method, notwithstanding the weaker nature of the south wall. From time to time parts of the south wall caved into the pit under the pressure, but ample warning of the imminence of a major movement of this nature was always given, and those working in the glory hole were not endangered. At the first signs of a big movement, the men were removed. During 1933, however, work in the bottom became more hazardous, rendered so by the increasing depth, the steep or even overhanging walls, and the ground movements brought about by the excavation of such a tremendous mass of rock. Work in the bottom of the glory hole was accordingly abandoned, and the remaining part of the main orebody is being mined by top-slicing.

Of some interest at present would be a brief description of the methods that have been used in surveying the glory hole. Customarily, the pit was surveyed annually to ascertain the tonnage and grade of the ore remaining at the end of each year. To do this, a plan had to be drawn with contours at 5-meter intervals, from which cross-sections 5 meters apart could be constructed. The first step in the survey was to run a closed traverse round the rim of the glory hole, starting and finishing with two permanent survey stations set in concrete. This work required about two days. From these stations, in the surveys of the earlier years, it was possible to take and record

all of the detail of the rim and slopes by stadia measurements. A station on the south rim was convenient for surveying the north slope of the glory hole, and vice versa. One engineer could keep two rodmen busy, each at the end of a rope for safety, and on the moderate slopes (about 50 deg.) that prevailed at that time, good speed could be made—say 50 shots per hour. An engineer could survey and plot all the detail in eight to ten days. Angles were never steeper than 30 deg., and stadia work gave a degree of accuracy compatible with the 5-meter contours of the plan.

As the hole grew deeper, the work of surveying presented more difficulties. Vertical angles became too steep to obtain accurate results with the use of stadia, and stations down in the hole had to be triangulated in from two or more of the rim stations. These supplementary stations were located on convenient ridges or in the mouths of old crosscuts, and from them all the detail of the lower part could be shot in, using stadia as before. Now, however, the walls were steep—almost vertical in places—and though the helpers had become extremely expert in crawling like flies over these cliff-like walls, the work naturally became slow.

For several years prior to 1932, only the eastern end of the pit had had to be surveyed, as no work was going on in the western half. In that year work was resumed in the west end, and the survey of 1932 was therefore a more comprehensive one than the surveys of preceding years. In addition, several interesting innovations were made, tending to increase both the speed and the accuracy of the survey. Stations were more numerous, especially down in the hole, and all those along the north rim were triangulated in from those on the south rim, in preference to carrying a traverse all the way round the hill. Several stations were located in convenient positions down on the bottom and their positions determined by applying the three-point problem. To obtain greater speed and accuracy on the steep walls, stadia surveying was given up, and in place of a rodman, a 4-in. diameter steel ball was attached to the end of the rope. This proved especially handy in rough or inaccessible places, and was much more accurate than stadia could ever be.

In employing the steel ball two methods of surveying were used. In the first, two transits, set up over stations, were used to take simultaneous sights at the ball, and both horizontal and vertical angles were read. On plotting the horizontal angles, the intersections of the rays gave the positions in plan of the points sighted. By measuring the horizontal distance on the plan, and multiplying by the tangent of the vertical angle, the elevation was then calculated. If this was done for both sets of readings, a first-class check was obtained on the accuracy of the reading and plotting. Any *mistake* (as distinct from a small *error*) in reading would appear when the elevation of a point, as calculated from the first station, showed a large discrepancy compared with the elevation calculated from the second station. This method, then, is speedy in the field, but rather cumbersome in the office. It requires two engineers, but affords an excellent check. The best intersections are obtained when the points sighted are near the circumference of a semicircle that has as diameter the base line joining the two stations (the angle in a semicircle being a right angle). The method finds its best application for distant points.

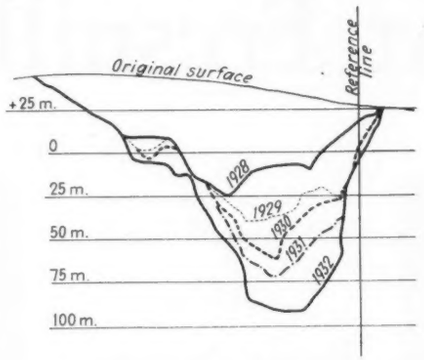

Fig. 1 — A typical cross-section through the glory hole at Fresnillo, showing the surface profile for the years 1928 to 1932 inclusive

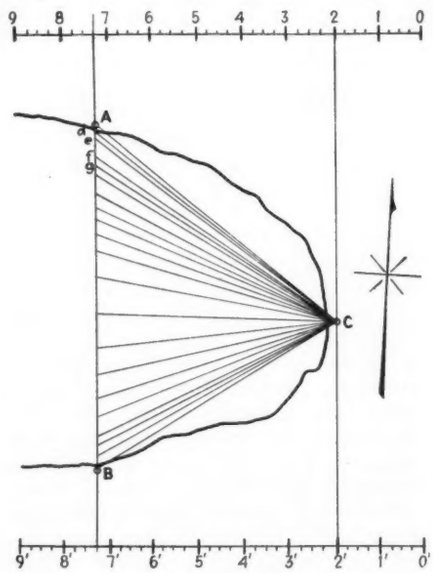

Fig. 2—A plan of one end of the glory hole illustrating the application of the method suggested for surveying it. For explanation see the text

In the second method, only one transit is used, and a steel tape is attached to a ring just above the ball. The ball can be so manipulated as to be brought quickly to any desired position, when it is sighted and readings of horizontal and vertical angles are taken, the slope distance being measured with the tape. This method can be used only for points within about 50 meters of the transit, where sag in the tape will be negligible. It has the advantage over stadia surveying on all counts—accuracy, safety, and speed in field and office.

This latest survey, made in 1932, took between two and three months. There were 45 stations and about 3,500 points. Of these points, about half were shot in by stadia, and half by the steel-ball methods.

In light of the experience gained at Fresnillo, the following method of glory-hole surveying would seem to be superior to any other that has been tried out, for pits that have to be surveyed annually, or more frequently, over a period of years: The first step would be to set stations along both sides of the glory hole, located exactly on the cross-section lines. These would have to be permanent stations, steel rods set in concrete or in solid rock, and far enough removed from the rim of the pit to be immune from subsequent mining operations or ground movements. Starting from a pair of these permanent points, both on the same section line, but on opposite sides of the glory hole, points on the two rims would be ranged in on the same line. A helper would be posted at each of these points, with a long rope reaching from one to the other across the pit. In the center of the rope there would be a ball to serve as a target. The engineer would locate himself with a transit at a station at the *end* of the glory hole. (See Fig. 2.) The helpers would start with the ball at one rim, lowering it for succeeding shots until it reached the bottom, then raising it similarly up the opposite side to the rim again. At each position of the ball, they would take care that it was on the section line—that is, directly between them and not off to one side or the other. The engineer would sight the ball at each point, reading horizontal and vertical angles and signaling to the helpers when to move the ball. The field work should be quite speedy, as the engineer could signal to the helpers as soon as he had taken each sight; then, while he was reading and booking the angles, they could be moving the ball to the next point.

The office work would consist of plotting the horizontal angles and marking the points where these rays crossed the section line; then measuring the horizontal distances from the station to the points, and multiplying each horizontal distance by the tangent of the observed vertical angle, thus obtaining the vertical distance and hence the elevation of each point. After marking these elevations on the plan, the cross-section could be quickly constructed, directly from the plan, without drawing in the contours. This would be quicker

than the method at present in use; also more accurate, because the cross-section would be composed of points actually surveyed and not just of interpolated points. All the cross-sections required would be treated in the same way as has been described. Then, if a contour plan were wanted, it could be easily drawn up in the usual way by interpolating between the points on the plan.

Fig. 2 is a plan of one end of a glory hole, showing the suggested method of surveying it. The numerals 0, 1, 2, 3, and so on, are permanent stations on the cross-section lines on the north side of the pit; 0′, 1′, 2′, 3′, and so on, are the corresponding stations on the south side. These permanent stations are, say, 20 meters apart, and from them the intermediate points, 5 meters apart, can be located by measuring with a tape. The sketch shows the method used in surveying one section (No. 7¼). The points on the rim where the helpers are posted are designated by "A" and "B." The letter "C" identifies the station, previously located from one of the permanent stations (No. 2, in the example shown), where the engineer sets up the transit. From "C" he measures the angles 2Cd, 2Ce, 2Cf, and so on, to the ball in its successive positions "d," "e," "f," and reads also the vertical angle for each sight.

Thanks are due to Thomas C. Baker, general manager of the Fresnillo Company, for his permission to publish the information contained in this article.

Novel Skip and Bucket Dumps

Devised at Small Properties With Economy as the Objective

THE devices illustrated in the accompanying figures were developed by lessees operating small properties, writes W. P. Crawford, from Bisbee, Ariz. Expense of a top man was saved through their use, as the hoisting engineer was able to dump skips or buckets from the engine room.

The skip dump shown in Fig. 1 is in use at a mine shaft in the Tombstone mining district, Cochise County, Ariz. Wire guides, of old hoisting cable, are used in the shaft, and the 1-ton skip was made in a local shop. It is a rectangular steel box, with an ordinary bucket bail at the top, and fastened, at the bottom, to a piece of 4-in. pipe by two U-bolts. The U-bolts are offset several inches from the center line, allowing the skip to dump in one direction only. They have sufficient play to revolve on the pipe, and lateral movement is prevented by collars. At each end of the 4-in. pipe, which acts as a crosshead, the bottom is flattened, and a hole is drilled to take a piece of 1-in. pipe for a guide shoe.

In this device, the chairs are made of two 8x8-in. stringers, pivoted at one end by a bolt, with the other ends connected by a bell crank and pitman. The mechanism is actuated by an endless cable, attached to the bell crank by clevises and passing over a tail block in the gallows frame, and by a control wheel in the hoist house. The control was made of a Model T clincher wheel, mounted above the hoist, with two wraps of the cable passed around it to prevent slipping.

In operation, the skip is hoisted above the chairs, the chairs are brought against the guides, and the skip is lowered. The ends of the crosshead extending beyond the guide shoes rest on the chairs, and, as the hoisting cable is slackened, the skip turns on the U-bolts and dumps into the bin.

At another shaft, the same type of chairs are used with a different actuating mechanism. In place of the bell crank and pitman, the endless cable passes around two single blocks at *A* and a tail block at *B*. The cable passing over the control wheel is clamped to one chair, the lower cable is clamped to the other chair, and turning the wheel produces the same effect as the bell crank and pitman. These chairs may be used in shafts having wooden guides if they are slotted to fit around the guides.

The bucket dump and shaft doors shown in Fig. 2 were used at a small property in Colorado during sinking operations and mining. Waste and ore were hoisted in buckets, without a crosshead, through a lagged shaft.

The doors are hinged at the bottom and, when open, are held several degrees from perpendicular by blocks mailed to the gallows-frame posts. They are opened from the hoist house by means of a line attached to each door. Counterweights partly compensate for their weight, and when the line is released the doors fall shut.

In this bucket dump the slide is made of a turnsheet. The sides are about 10 in. high, and a slot to catch the bucket tail chain is cut at the upper end. The sides are drilled for the hinge rod, and the slide is mounted on a cross-member with the lower end protruding over the chute, to lessen spill. A better method, however, would be to rivet hinges under the slide, as this would protect the hinge rod.

The slide is pulled into the shaft from the hoist room by a wire cable attached to one side, and is supported in this position by a chain. Another cable passes over a block and carries a counterweight sufficiently heavy to pull the slide to an upright position when the hoist-room cable is released.

Fig. 1—Skip-dumping device in use in the Tombstone district, Arizona. Fig. 2—A bucket-dumping device, employed at a Colorado mine. The doors are operated from the hoist

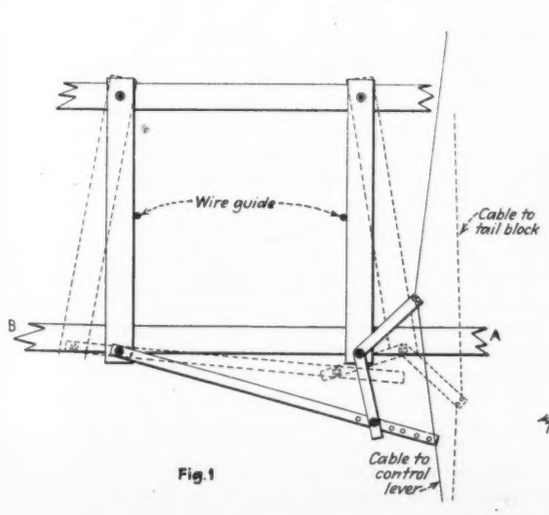

Fig. 1

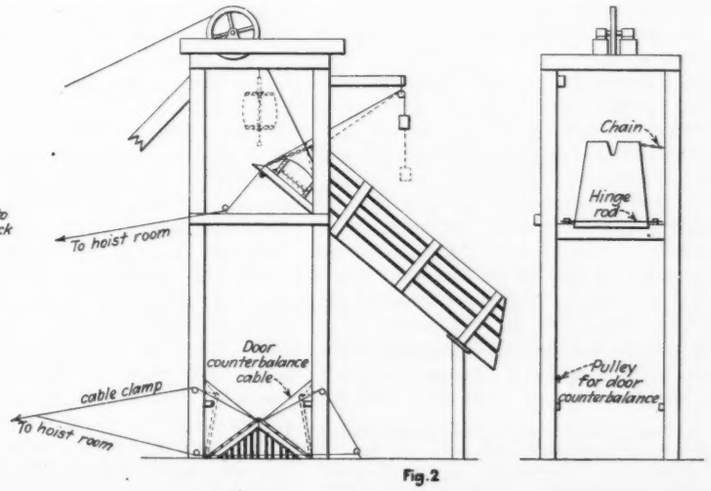

Fig. 2

Wanted—An Index for Measuring the Surface of a Mineral Powder

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Such surfaces cannot be derived mathematically from screen sizing, grain counts or sedimentation analysis alone

A form of determination is required which relates surface to weight

The author suggests methods which he has found valuable for this purpose

CONNECTION between grain shapes and surface in mineral powders is receiving increasing industrial attention, especially in the grinding and uses of fuel and cement and in ore treatment. Different crushing and grinding machines produce grains of different shapes in the final product, and these characteristics are not definitely exposed by screen, microscopic, or sedimentation analysis. Herewith are presented some elementary discussions of the causes and, also, a method of measuring surface changes due to different grain shapes.

The conception of a specific surface of a powder is old,[1] especially in soil analysis, but the importance of this conclusion as applied to the surface of ore grinds has not been generally appreciated in America, though in recent years it has been given considerable study in Europe.[2] This conception renders obsolete and unreliable most old theories on grind analysis and calls for material revision of virtually all studies in which surface measurements are interpreted as an index of the energy employed in grinding. This applies most specifically to comparisons between different types of grinding or crushing machines.

In general, screen analyses of grind products have been accepted as the measure of the surface and fineness of a powder, but if the fineness of a powder be defined as the number of grains per unit volume, or surface per unit volume, the fallacy of screen sizing as a means of measuring this can be illustrated by a simple example. For instance, a ton of steel cubes, each of 1-in. edge, would be of a certain mesh size and contain a definite amount of surface, but a ton of steel sheets each 2 in. square and one one-hundredth of an inch thick would be represented with screens as a coarser mesh size, and yet it would contain many more "grains" and much more surface than the ton of inch cubes of a finer screen mesh.

This conception suggests the fact that the specific surface of a unit volume of a screen mesh size depends upon the grain shapes, and that one is therefore likely to draw too strongly on the mental picture of a unit volume of galena grains, say of 10 mesh size, and compare it with the same volume of mica grains of the same mesh size. Though one does have here a marked difference in specific surface, or of fineness, the important thing is that one does not have to compare two different minerals to gain this comparison, because the same type of difference in specific surface per mesh volume occurs with any one mineral. This depends upon the type of grinding machine used, the mode of operation of that machine, and the position of the particular mesh size in the screen analysis of the grind product. This is due to the fact that fractures in different directions through mineral crystals have different energy equivalents per unit area of fracture.

For example, take a book of mica. It is relatively easy to create surface with little expenditure of energy by peeling off sheets, but to create the same amount of surface in a direction at right angles to the plane of these sheets requires a very much greater expenditure of energy. Evidently, therefore, one must know something about the relative proportion of the different classes of surface produced before one can make any attempt to estimate the energy used in producing the surface of a mineral powder.

A second example may now serve continued thought. Orthoclase is a mineral of monoclinic crystal structure having two cleavages at right angles to each other. The cleavage parallel to the *b* axis is easy, whereas that parallel to the *c* axis is more difficult. The energy needed to create a unit area of surface parallel to the *c* axis is greater than that required to produce the same surface parallel to the *b* axis. More-

[1] Krauss: Inter. Mett. für Agricultural Science (Bodenkunde) 13, 147 (1923).

[2] Heywood: "Calculation of the Specific Surface of a Powder." *Trans.* Inst. Mechanical Engineers (British), December, 1933.

over, a fracture parallel to the *a* axis, where no cleavage exists, requires still more energy per unit of surface. Evidently, here the energy value per unit of total surface is a variable depending upon the amount of surface of each class present and this again is linked indirectly to the average grain shape.

Grain Shape and Force Application

The causes of variable grain shapes, as has been stated, depend, among other things, upon the nature of the grinding machine and its mode of operation. More fundamentally, this depends upon the degree and rate of force application. Orthoclase, for example, when subjected to a gradual application of force so that elastic strains have a chance to be transmitted, tends to crumble along surface directions which require the least energy per unit of surface. On the other hand, the crushing of a fragment of orthoclase on an anvil with a heavy hammer produces more fractures in all directions, because the elastic strains have not had time to act. Here the arguments of Rittinger and Kick may again be considered, not for the purpose of choosing sides, but rather to bring together the landmarks established by these men into one general formula only. Each man saw the extreme applications of a single mathematical form. It is true, also, that experiments made to relate surface produced in grinding with the energy input, first by Martin in England[3] and later by Gross in the United States,[4] tended to confirm Rittinger's viewpoint. However, one must recall the fact that each experimenter compared only one form of machine type and operating mode, which tended to produce only one general average type of grain shape, so that surface necessarily remained a direct proportional.

Virtually every type of grinding machine produces a certain characteristic grain shape of the product. For example, on dolomite the hammer mill produces a more nearly cubical grain, products of gyratory crushers are wedge shaped, pyramidal and flat, and the products of crushing rolls are mainly splinters.[5] On the other hand, products of rod mills, ball mills, and stamps all produce grain types characteristic of the machine and the operating conditions as well as ore characteristics. All these changes of grain shape profoundly affect the amount and kind of surface per unit mesh volume, and this reflects a variable instead of a constant coefficient whereby this surface value is to be interpreted as a measure of the energy input in grinding and crushing. Clearly, therefore, this coefficient for any material varies with the type of machine and its mode of operation. Further, this coefficient varies from mesh to mesh in the product of one kind of grind, as will be shown in later illustrations.

The industrial significance of these conceptions is of the greatest importance. In the grinding of cement clinker and fuels, grind types which produce the greatest surface per unit mesh volume yield the fastest and strongest cements and fuels with the highest temperatures of combustion. In ore-concentration processes, grind types are of very great importance and must be adjusted for the type of ore treatment used. Cubical grains are best for jigs and gravity concentrators generally, whereas the more flattish types of grains are generally, but not universally, best for flotation treatment. In the production of concrete sands cubical grains are best.

An Index Wanted

Virtually none of the methods used for size analysis of powders supplies an index by which the characteristic grain shape or surface of the grains can be measured. I have already noted the difficulty with screens, but microscopic grain measurements or counts and sedimentation analysis throw but very little additional light on the subject. The purpose of this article is to suggest methods which I have found valuable for such form of measurement. This method of treatment serves to distinguish, with an index, surface changes due to grain shapes. It retains the tri-dimensional features of a cube and the actual tri-dimensional changes of other grain shapes are considered proportional to changes in one dimension only of a cube. The method is therefore an approximation.[6]

Referring to Fig. 1, let x be the edge of a cube, then the area of the cube is $6x^2$ and the area of any slab is $4ax + 2x^2 = 2x(2a + x)$. Let $f(x)$ be the equation of grain numbers considered as cubes; then $6x^2f(x)$ is the surface function.

Suppose now the weights of actual ore grains are determined on each screen size; also, let the theoretical weight per grain be W, considering grains as cubes of an edge value equal to the mean screen aperture value. Let the actual weight found by weighing an average of 100 grains be W_1.

Let the ratio $\frac{W}{W_1} = \frac{x}{a}$ in Fig. 1, or

$$\frac{x}{a} = R = \frac{W}{W_1}, \text{ or } a = \frac{x}{R}$$

The surface per grain is

$$2x\left(\frac{2x}{R} + x\right), \text{ or } 2x^2\left(\frac{2 + R}{R}\right)$$

Now, therefore, the actual number of grains in the product of the grind is

$$\int_{x_1}^{x_2} Rf(x)dx$$

and the proportional surface then becomes

$$\int_{x_1}^{x_2} R\left[2x^2\left(\frac{2 + R}{R}\right)\right]f(x)\,dx$$

or

$$\int_{x_1}^{x_2} 2x^2(2 + R)f(x)\,dx$$

But the theoretical cubic surface is

$$\int_{x_1}^{x_2} 6x^2f(x)\,dx$$

Hence

$$\frac{\int_{x_1}^{x_2} 2x^2(2 + R)f(x)\,dx}{\int_{x_1}^{x_2} 6x^2f(x)\,dx} = \frac{2 + R}{3}$$

To this value I shall give the name Surface Index, or S

Hence

$$S = \frac{2 + R}{3}$$

The approximate surface function then becomes

$$\int_{x_1}^{x_2} 6\left(\frac{2 + R}{3}\right)f(x)\,dx =$$

$$\int_{x_1}^{x_2} 2(2 + R)x^2f(x)\,dx$$

From this form one may note that if the grain shape happens to be a cube, $R = 1$ and the form becomes

$$\text{Surface} = \int_{x_1}^{x_2} 2(2 + 1)x^2f(x)\,dx =$$

$$\int_{x_1}^{x_2} 6x^2f(x)\,dx$$

Table I—Surface Per Unit of Weight Figs. 1 to 9 Inclusive

Figure	Surface per Unit of Weight $6\left(\frac{2+R}{3}\right)$*	Actual
1	6.00	6.00
2	10.00	9.71
3	8.00	8.82
4	6.00	7.83
5	12.00	10.83
6	13.26	10.95
7	8.62	8.89
8	8.26	7.38
9	16.00	13.95
Total	87.14	84.36
Average	9.68	9.37

*These R values are computed from the values of the geometric shapes.

[3]Martin: Connection between the surface area produced and the work done in tube-mill grinding of quartz sand. *Trans. Ceramic Soc.* Vol. XXV, 1925-26.

[4]Gross & Zimmerly: Crushing and Grinding—III. A. I. M. E., Tech. Pub. 127 (1928).

[5]Report of the Norris dam investigation to determine the best type of crusher for concrete sands: T.V.A.

[6]Only an elementary mathematical discussion will be presented here. A more exacting treatment, which reduces to the same form, draws heavily on the calculus of probability in the solution of the problem: "The probable mean surface of a prismoidal body which may pass through a square hole."

which is the cubic surface function. For other forms of grain shapes, all of a unit screen mesh size, such as are shown in Figs. 2 to 9, inclusive, the data in Table I will illustrate the probable mean surface relationships.

The surface index, or S, is merely a coefficient into which the cubic surface is multiplied to obtain the probable mean surface for grain shapes other than cubes, or if $6x^2$ is the surface of a cube of x mean aperture, then the probable mean surface of other grains of the same mesh size, but of a different shape so as to yield a mean weight factor, such as R, is

$$6\left(\frac{2+R}{3}\right)x^2$$

In the application of this principle the grains on the screen sizes are counted and weighed and average weights of grains thus obtained. It can be shown in binomial theory of fracturing[7] that the R values thus computed should follow an asymptotic function (in log y and n values) which converges rapidly to a constant value. In practice this characteristic is found true to theoretical form.

Results of grinding two pure minerals in a disk grinder to approximately the same condition of powder are shown in Table III, on p. 339.

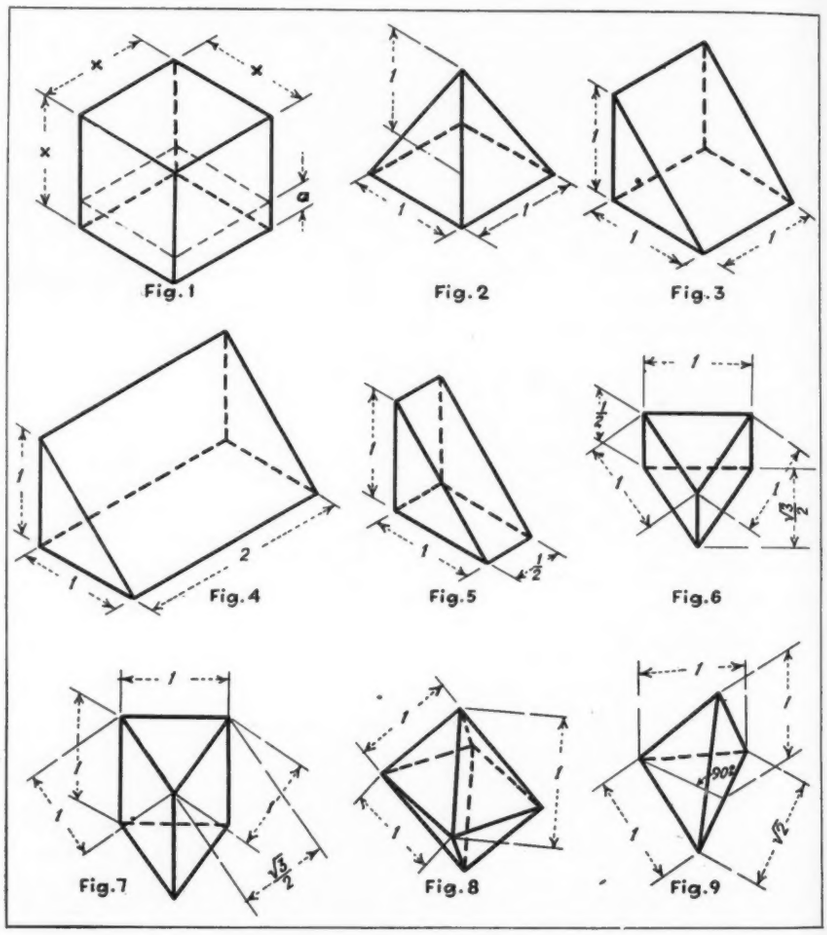
One may note in Table III that the R values for a mineral powder are greatest on the coarser meshes, but that they rapidly converge to a constant value as the mesh sizes become smaller. When this constant value is found, usually by averaging the finest meshes yielding substantially constant values, then this value is applied to all sizes smaller than the finest screen used.

Counting the Grains

The labor of counting grains may be greatly reduced and much time saved by drilling ten, or more, holes, well spaced from each other, in a thin metal plate large enough to cover completely an ordinary microscope slide. The diameter of the holes should be somewhat less than the field of view of the microscope. In application, the plate is placed over a slide and grains are then dusted over the plate. The plate is then carefully *lifted* from the slide and samples of the grains will be found on the slides in groups, each of which will be entirely in the field of view. If the spacing of the holes in the metal plate has been liberal, the individual groups may be counted easily without overlap or confusion. After counting, the grains are carefully transferred to a scale pan and weighed. For weighing the finer grains a gold assay balance, sensitive to 0.005 mg., is recommended.

The remarkable habit of the R values is found true to form in all products of a grinding operation from mine-run ore to crusher discharges and from ball-mill discharges to classifier overflows. This demonstrates the fact that comminution is a cyclic process in which the reduction in size is a process of passing through various grain shapes from flattish to blocky types and from blocky types back to flattish forms and so on, even though there is a difference in form caused by machine types. For example, Table II gives the distribution of the grain weight ratio values found in the products of a mill.

In this one perceives an approach to a constant value in the finest sizes of all products, but the grain characteristics of the coarser mesh sizes of each product are nowhere identical. The recurrence of flattish forms localizes in the coarsest sizes. For example, if one examines the + 28 mesh products the fact becomes apparent that this product in the classifier overflow is not typical as to grain shape or surface of the same mesh product in the ball-mill discharge, and likewise the latter does not identify the grain type in the crusher discharge. A study of results such as these shows that crushing diagrams, such as the Gates, cannot be reliable, for grinding is something different than a constant ratio change of surface per mesh unit from screen size to screen size from the infinite mass down to some assumed screen size, and, further, that any rule or formula that assumes that a grain or grains, say on 28 mesh, in the classifier overflow is the same in surface value as a grain or grains on 28 mesh in the ball-mill feed or crusher discharge, must be considered doubtful



Figs. 1-9. Diagrams of grain shapes, all of a unit screen mesh size

Table II—Distribution of Grain-Weight Ratio Values in Mill Products

Mesh	R Values		
	Cone Crusher Discharge	Ball Mill Discharge	Classifier Overflow
+½ in	2.44		
0.371 in.	2.19	2.76	
3 mesh	2.06	2.41	
4 mesh	1.99	2.35	
6 mesh	1.87	2.20	
8 mesh	1.76	2.06	
10 mesh	1.69	1.97	
14 mesh	1.68	1.97	
20 mesh	1.62	1.88	
28 mesh	1.60	1.82	2.27
35 mesh	1.55	1.72	1.96
48 mesh	1.56	1.63	1.73
65 mesh	1.57	1.53	1.60
100 mesh	1.56	1.55	1.55
150 mesh	1.55	1.52	1.52
+200 mesh	1.55	1.51	1.53

[7]Weinig: "A Functional Size-Analysis of Ore Grinds." Colorado School of Mines Quarterly, XXVIII, 3, July, 1933.

until some other proof than screen sizing is forthcoming.

A very common example of such misconception is the so-called Dean, Dorr Company, or Newton formula for classifier efficiency.[8] The fundamental mathematical evolvement of this form is without question entirely sound, but it is based on the erroneous assumption that the amount of oversize in the classifier overflow identifies, measures, and feed, and still less so do they measure functionally or otherwise the escape of unclassified feed as a whole.

The significance of these concepts may well be illustrated by an example. A crusher discharge product was found to have the screen analysis given in Table IV.

The regular Gates diagram of this product is shown in Fig. 10 as the curve *ABC*, wherein the cumulative per cent

Table III—Results of Grinding Pure Orthoclase and Pure Galena to Approximately the Same Condition of Powder

Orthoclase Sp. Gr. 2.6 Hardness 6

Ordinal Number	Per Cent Weight	Average Grain Weight, Milligrams	Weight of Cube $\delta = 2.6$	R
51	0.2	16.78	58.8	3.51
50	0.7	8.47	20.8	2.46
49	3.0	3.20	7.3	2.28
48	5.6	1.29	2.6	2.01
47	7.2	0.505	0.92	1.82
46	13.4	0.188	0.325	1.73
45	14.2	0.065	0.115	1.77
44	13.3	0.024	0.0407	1.70
43	10.3	0.0083	0.0144	1.74
42	6.9	0.00293	0.00509	1.74
41	6.7	0.00104	0.00180	1.74
—200 mesh	18.5			
Colloidal	0.052			
Average of last three sizes				1.74

Galena Sp. Gr. 7.5 Hardness 2.5

Ordinal Number	Per Cent Weight	Average Grain Weight, Milligrams	Weight of Cube $\delta = 2.6$	R
50	0.1	22.45	62.5	2.72_9
49	1.0	10.01	22.2	2.25_5
48	4.0	3.85	7.5	1.9^5
47	6.9	1.58	2.75	1.74
46	11.8	0.61	0.97	1.59
45	14.4	0.228	0.343	1.50
44	15.2	0.085	0.122	1.44
43	11.9	0.0304	0.043	1.42
42	8.0	0.0108	0.0153	1.42
41	6.8	0.00381	0.0054	1.42
—200 mesh	19.9			
Colloidal	0.123			
Average of last three sizes				1.42

Table IV—Screen Analysis of Crusher Discharge Product

Mesh	% Cum.	%(P)*	R	S	P×S
+4	0	0			
6	1	1	2.76	1.59	1.59
8	8	7	2.11	1.37	9.59
10	21	13	2.05	1.35	17.55
14	35	14	1.96	1.32	18.48
20	48	13	1.88	1.29	16.77
28	58	10	1.72	1.24	12.40
35	66	8	1.65	1.22	9.76
48	72	6	1.58	1.19	7.14
65	79	7	1.42	1.14	7.98
100	84	5	1.41	1.13	5.65
150	87	3	1.43	1.14	3.42
200	88	1	1.41	1.13	1.13
—200	100	12			

*P = Individual screen weight in percentage.

mained consistently as cubes. Conception of a surface index suggests that this is not true, and hence the very basis upon which the Gates diagram rests is insecure.

Fortunately, one may use the same diagram in another way and escape from the difficulty just mentioned. In this case curve *GHI* represents the direct plotting upward of the individual mesh weights on each screen. Then the area below this curve represents the total proportionate surface of the screen sizes in the grind when the grains are considered as cubes. Having established the R value by weighing the grains, one may compute the S values as shown, and having found them may multiply the individual per cent weights by the corresponding S values and replot these figures as curve *JKL*. Then the area below this curve is the total proportionate index surface of the screen size products in this grind. In this case, of course, the elemental surface areas lie in positions shown as *OYUT* and *QZUT*.

Diagrams such as these are useful mainly for study of the screen sizes, but the value of such proportionate surfaces is of questionable significance as a measure of the total surface of the grind product. Usually, the total surface of a mineral powder is largely confined to the minus-200-mesh material; the plus-200-mesh material contains only a very small proportion of the total surface. Furthermore, the minus-200-mesh material is by no means of constant surface value per unit of weight.

Because of these fundamental difficulties a tendency is growing to consider a function as representing the distribution of grain sizes in a powder. This function is established in the range of fine sizes by the use of a microscope or sedimentation balance and in the coarser sizes by the use of screens. An exponential law generally results from this.

Credit for the first investigation to discover the law of grain composition belongs to Martin, Blyth, and Tongue.[9] Martin employs the form

$$\frac{dN}{dx} = ae^{-bx}$$

The determination of grain composition of dust-like materials, in particular of cement, was investigated in Germany.[10] The article mentioned includes 80 fineness analyses of other grists investigated (cement, gypsum, magnesite, ground clay, pigment, heavy spar, quartz, flint, ground glass, and ore). Concerning this there appeared a particular work of Rammler which contains further results concerning coal dust. So far as these investigations reach, the exponential law for grain composition is

establishes the total amount of classifiable feed from the grinding unit to the classifier feed which escapes in the classifier overflow. The application of the weight-ratio test, described in the foregoing, invariably proves that the oversize grains in a classifier overflow are of quite a different type from the same mesh sizes in the classifier feed, and here there is grave doubt of the value of this measure. The oversize grains are selected according to shape and do not represent the mean size grain type of the same mesh in the classifier

weights are plotted. That area above and to the right of this curve is taken as proportional to the work done in crushing on the material shown by the screen analysis. The fundamental reason for this is that the work done on any mesh size is considered as an element, such as *BD* (6 per cent on 48 mesh, for example), which identifies an area such as *BDFE*, which represents the sum of a geometrical series with an infinite number of terms. This area, therefore, is then considered proportional to the work done in crushing, say, 6 per cent of the product from the infinite mass down to 48 mesh. The theorem would apply, of course, to a homogeneous substance wherein all the grains re-

[8]The full credit for this formula properly belongs to R. T. Hancock, of London, England, who first developed the form with discussion in *Eng. & Min. Jour.*, Sept. 25, 1920.

[9]Researches on the theory of fine grinding: Trans. of the Ceramic Society, Vol. 28. Session 1923-24, Part II.

[10]Zement, Vol. 17, Nos. 50-52 (1928)

valid for all mineral substances in the region of *fine* grinding.[11]

Weinig[12] developed the use of functional forms adapted to Tyler standard screen sieves. The exponential law of Martin is made a special case of a more general exponential law or form of probability. A mathematical theory is developed.

All these functional forms permit the application of a surface index for the evaluation of surface, and therefore, in order to complete the application of this principle, it will be necessary to illustrate the application of some of these functional forms. A rapid method for determining the cubic surface of ore grinds for the minus-200-mesh material is as follows:

Let w_t = + 200 mesh weight, t = ordinal 41, n = any ordinal number [13],
p = cubic surface per c.c. at ordinal t, δ = density of ore,
S_e = cubic surface at ordinal n, w = weight on ordinal n,
S_t = cubic surface on ordinal t.

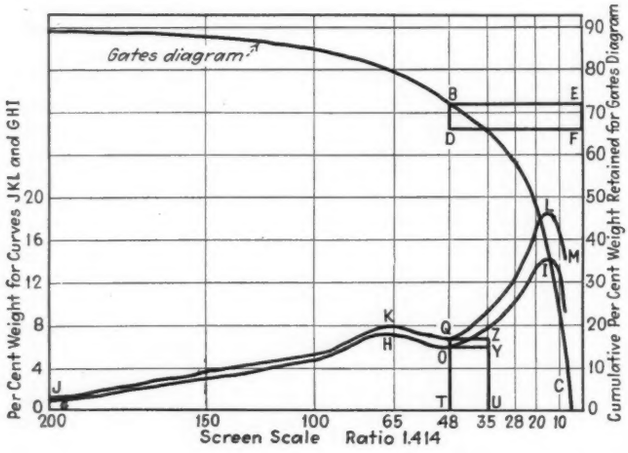


Fig. 10—The Gates diagram of crusher discharge product. Also curves for determining the proportionate surfaces of the screen size products in the grind

Then $$S_e = \frac{w}{\delta} p \sqrt{2}^{(t-n)}$$

But $\log w = K_1 n - C_1$ (Footnote 14)

or

$\log S_e = K_1 n - C_1 - \log \delta + (t-n) \log \sqrt{2}$

Wherein $K_1 n - C_1$ is the log weight line.

Also $$-\log \delta + \log p = \log \frac{p}{\delta}$$

and $(t-n) \log \sqrt{2}$ is a linear function.

[11]Rosin-Rammler: The evaluation of sieve analysis and index lines for coal dust, A.f.W., Vol. 6, No. 2, page 42, (1926). Rosin, Rammler, and Sperling: Berichte des Reichskohlenruts, C. 52.

[12]A functional size-analysis of ore grinds, Colorado School of Mines Quarterly, Vol. XXVIII, No. 3, July, 1933.

[13]Ordinal numbers are simply numbers for screen sizes which are carried down to the finest limit of a powder. They are term numbers of a geometrical series of which the first turn is about 1 Angstrom unit and the 41st turn happens to fall on + 200 — 150 mesh size.

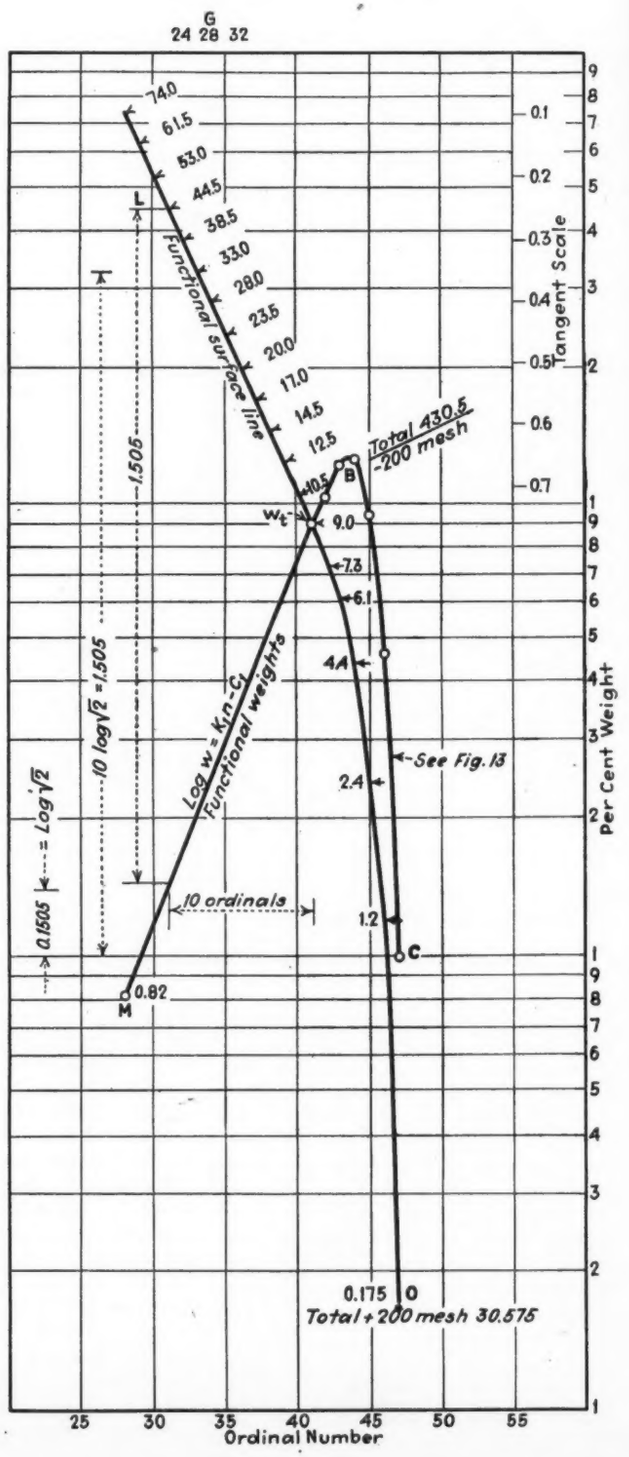
Hence, in Fig. 11, if $\log w = K_1 n - C_1$ is the line of log weights,[15] the minus-200-mesh cubic surface line may be drawn by taking logarithmic offsets from the weight line in amount equal to $(t - n) \log \sqrt{2}$. This may be done most conveniently by stepping back 10 ordinals and offsetting up 10 log $\sqrt{2}$ equals 1.505 log units to L. Draw $L - w_t$. Then the sum of the intercepts along this line multiplied by $\frac{p}{\delta}$ is the minus-200-mesh surface if t is ordinal 41. In Fig. 11, if $\delta = 2.6$, then $430.5 \times \frac{.068}{2.6} = 11.26$ square meters of minus-200-mesh cubic surface.[16]

[14]This is the weight-adjusted equation of the linear logarithmic plot of microscopic grain counts, wherein K_1 and C_1 are constants.

[15]See Chapter X of "A Functional Size-Analysis of Ore Grinds."

[16]See "A Functional Size-Analysis of Ore Grinds," Table I, Column 7, Ordinal 41.

Fig. 11.—Chart for evaluating surfaces of ore grinds



For the plus-200-mesh surface, since the cubic surface per mesh, or ordinal weight, varies as $\sqrt{2}$ regardless of functional distribution, one also has

$$S_s = \frac{w}{\delta} p\sqrt{2}^{(t-n)}$$

or

$$\log S_s = \log w - \log \delta + \log p + (t - n) \log \sqrt{2}$$

With log w values plotted from screen analysis which produces the curve in the plus-200-mesh region, one may similarly plot the surface curve $w_t - 0$ by taking logarithmic offsets *down* from the log weight curve in amount $(t - n)$ log $\sqrt{2}$. The sum of the ordinal intercepts of this surface curve multiplied into the factor $\frac{0.068}{\delta}$ then gives at once the plus-200-mesh cubic surface in square meters in a 100-gram sample. Thus in Fig. 11 the sum of the ordinal intercepts of this plus-200-mesh surface curve is 30.577 and $30.577 \times \frac{0.068}{2.6} = 0.81$ square meters cubic surface.

The total surface is the sum of the minus-200-mesh surface and the plus-200-mesh surface, or, in the illustration of Fig. 11, 11.26 + 0.81 = 12.07 square meters cubic surface in a 100-gram sample. This theory is worked out for an ore with a specific gravity of 2.6;

Fig. 12—Ore grind chart for orthoclase

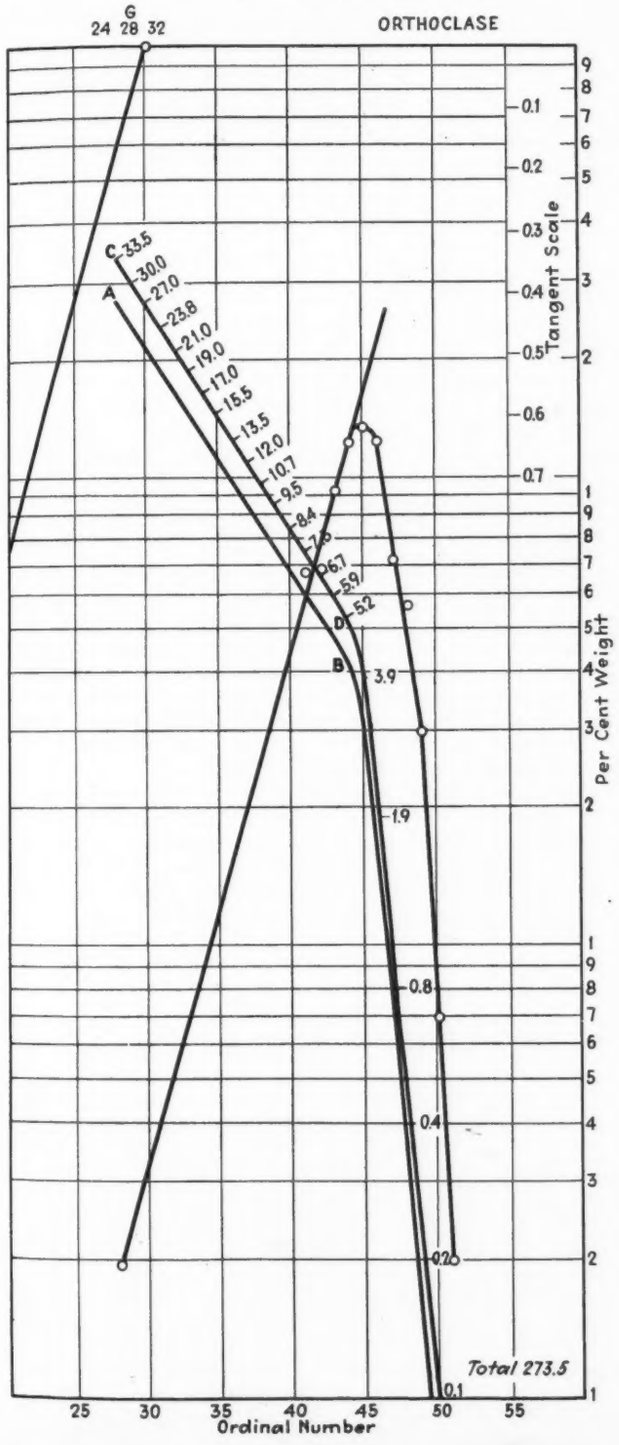
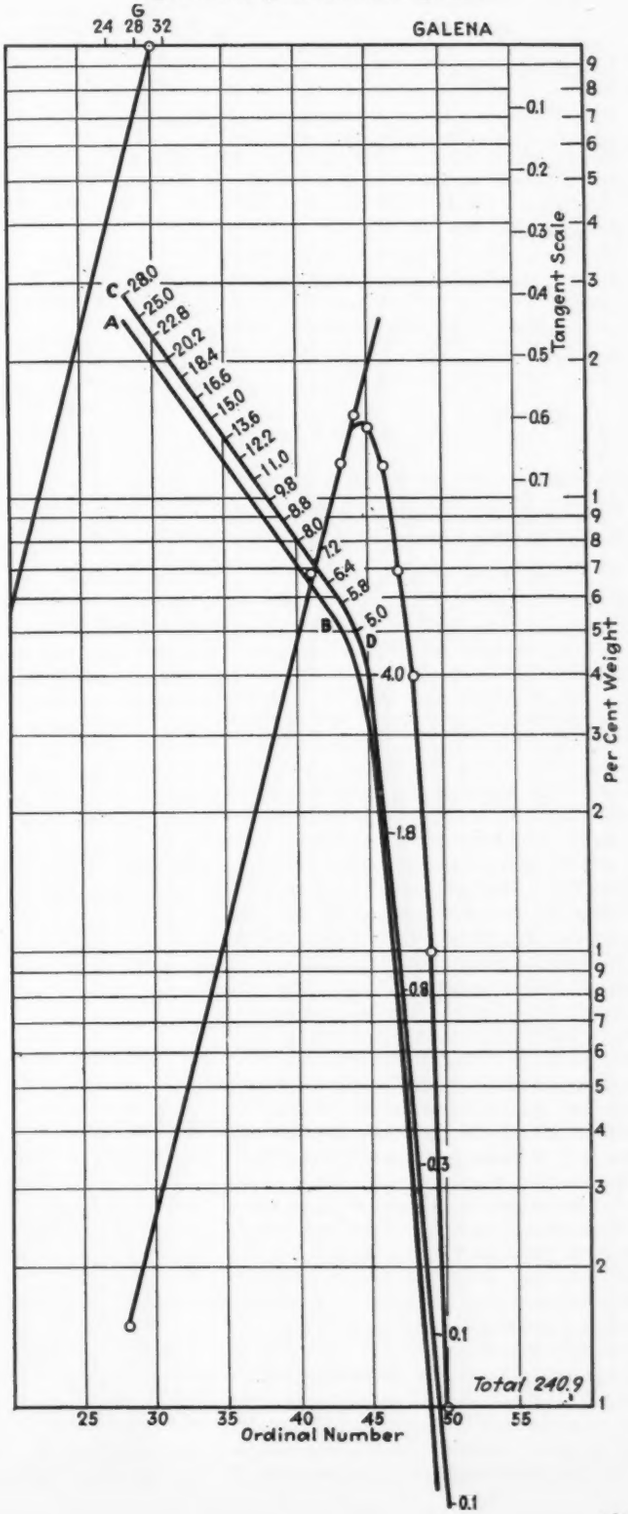


Fig. 13—Ore grind chart for galena



for any other specific gravity, as for instance 2.85, the result would have to be corrected as follows: $12.7 \times \frac{2.60}{2.85} =$ 11.0, approximately, square meters cubic surface.

Returning now to the examples of orthoclase and galena, the cubic surface functions are shown in Figs. 12 and 13 as the curves *AB*. However, the *R* value for orthoclase has been found to be 1.74 and for galena 1.42. Hence

$$S \text{ for orthoclase is } \frac{2 + 1.74}{3} = 1.25$$

$$\text{and } S \text{ for galena is } \frac{2 + 1.42}{3} = 1.14$$

In Fig. 12, for orthoclase the cubic surface line is *AB*. This surface corrected by the surface index is line *CD*. The line *CD* is, of course, drawn through the fine sizes as a constant offset from the line *AB* in the amount of log 1.25. In the coarser sizes the individual surface indices are used for each ordinal. The total intercept value is 273.5. The index surface then becomes, when the density is 2.6

$$273.5 \times \frac{.068}{2.6} \times \frac{2.60}{2.60} = 7.15 \text{ square meters index surface per 100-gram sample.}$$

Similarly, for galena, when the density is 7.5 (see Fig. 13)

$$240.9 \times \frac{.068}{2.6} \times \frac{2.60}{7.50} = 2.18 \text{ square meters index surface per 100-gram sample.}$$

The value of this form of surface evaluation as a measure of energy input in grinding cannot be accepted entirely at its face value as applied to a mineral, or an aggregate of minerals, which have different values of cleavage or belong to different crystal systems. Fractures along different cleavages, or across cleavages, in most cases have entirely different energy values, and for this purpose one must estimate the amount of the different classes of surfaces produced and proportionally evaluate the energy equivalent. This view, of course, is a complication, but it must not be overlooked in energy studies.

One must constantly be on guard against boldly considering surface as a measure of energy input in grinding, for it is possible for a machine to apply this energy in such a way that a great amount of surface is made in flat grains along crystallographic directions which require the least energy input. On the other hand, another machine may apply the energy input in such a way that cubical grains of least surface are created, but this surface is exposed along crystallographic directions which require a great deal of energy input per unit of surface produced. Clearly, in these cases surface is not a true comparative measure of the energy input of the two grind types or machines. However, with minerals of a cubic crystal structure this index surface may be accepted as approximately proportional to the energy input in grinding or crushing.

Among the conclusions which may be deduced from studies of this nature is that the surface of a mineral powder is indeterminate and cannot be derived mathematically from the screen analysis alone. The same generality applies to other forms of size measurement such as microscopic grain counts and sedimentation analysis. All that such forms of measurement yield is the weight distribution. To evaluate surface from these forms of measurements, some other form of determination must be made which relates surface to weight. This article is confined to the application of a surface index to supply the required equation so that the indeterminacy of surface can be solved. The surface so evaluated, except in special cases, need not be related to the energy input by a constant factor in grinding of a material, but in cement and fuel grinding and in certain metallurgical investigations this surface yields important industrial information concerning chemical activity of the powder and of grain shapes or metallurgical surface.

The index surface so described still remains indefinite in the matter of the energy equivalent of the surface. To solve this, other equations are required, which must relate the amount and kind of the different classes of surface present to their individual energy equivalents, or other determinations must be made to identify the energy equivalent of the mean surface. These matters are beyond the scope of this article.

Mining Costs at Michigan Iron Mines

PRODUCTION COSTS delivered at Lake Erie ports for iron ore mined underground on the Gogebic range, in northern Michigan, in 1934, averaged $4.2544 per ton, according to F. G. Pardee, mine appraiser, and W. Osgood, geologist, respectively, for the Michigan Geological Survey. Of this, the cost of mining was $1.6596 (and $0.2145, deferred mining cost), taxes were $0.4708, general overhead was $0.2532, transportation, $1.6213, and marketing, $0.0350. Other ore costs were $0.3655 per ton for royalty and $0.0229 for interest on borrowed money.

Corresponding costs per ton for ore produced by underground mines on the Marquette range are: Total, $3.6277; cost of mining, $1.4722; deferred mining cost, $0.0681; taxes, $0.2673; general overhead, $0.3038; transportation, $1.4301; marketing, $0.0862. Royalty cost (not included in the preceding total) was $0.2359 and interest on borrowed money amounted to $0.0145.

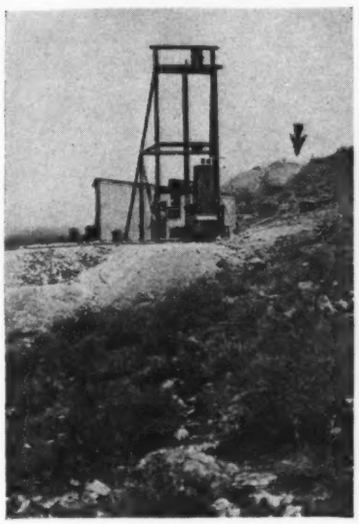
For the underground iron mines of the Menominee range, the corresponding per ton costs for 1934 are: Total, $3.8905; cost of mining, $1.6483; deferred mining cost, $0.1640; taxes $0.2226; general overhead, $0.3067; transportation, $1.4775; marketing, $0.0714. The royalty cost was $0.2602 additional and interest on borrowed money $0.0575.

Underground mines operated by the State showed the following per ton costs: Mining, $1.5760 (plus a deferred charge of $0.1413); taxes, $0.3353; general overhead, $0.2852; transportation, $1.5160; and marketing, $0.0653, the total being $3.9191.

Costs at siliceous open pits were: Mining, $0.3382 ($0.0481 deferred); taxes, $0.0352; general overhead, $0.1196; transportation, $1.4058; and marketing, $0.0937. The total was $2.0406 per ton.

Gold in Petrified Wood

DISCOVERY of gold in petrified wood, which in turn is buried in volcanic tuff, is described by Prof. W. S. Palmer, of the Mackay School of Mines, at Reno, Nev., in a bulletin issued by the school. The find is credited to Edward and Frank Nugent, Clayton Kroh, and William Johnson. The wood occurs in the form of logs, now turned to crystalline and chalcedonic silica, carbon, and calcite, and is found near the camp known as Nigger or Tucker Wells, in the northern part of the Aspen district in Churchill County, Nev. Here the formation is chiefly volcanic tuff cut by dikes of andesite and overlain by basalt in certain parts. Some zones are highly silicified, due to hot-water action. The area containing the logs is about 500 yards square, only a small part of which has disclosed logs carrying gold. As observed thus far, the gold occurs as both irregular and crystalline grains in the spaces between the quartz crystals. Most of it is in the form of individual crystals, the common forms noted being the octahedron, cube, and dodecahedron and combinations of these. The largest crystal was 0.40 mm. in diameter. Sampling showed that the logs differed widely in gold content, the average value being moderate.



CACTUS QUEEN prospect on the Middle Buttes, in the Mohave district. The arrow indicates the tunnel of Blue Eagle mine

Activity Spurred In Camps of Southern California

Recent finds and present metal prices rouse optimism, encourage search, lure capital—No wild boom, however

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THE SETTLED ATMOSPHERE characteristic of old-established mining camps is not productive of good results. Miners, prospectors, and capitalists get listless, whereas a new strike of rich ore in an old mine, or the discovery of a new one, brings inspiration to the community, and draws out dormant capital. By a singular concatenation of circumstances this is now happening in nearly every district in Southern California. The strikes recently made on Soledad Mountain and on Middle Buttes, near Mohave, and at Neenach, coupled with prevailing higher prices for gold and silver, and improved methods for mining and treating gold ores, are the principal factors responsible for the present revival of gold mining throughout the State. As to the gold rush and consequent boom in the Mohave area, the visitor will find it a rather orderly affair, largely because of the fact that the greater part of the land there is privately owned, and, therefore, not open to location. However, this has not stopped responsible people from entering the field and securing leases with a view of prospecting and developing the available mineral land. Most of the mining districts are accessible by automobile and by rail, and proximity of large centers assures a steady supply of materials and food at reasonable prices. The southern part of the State is especially favored by an extensive network of electric transmission lines, and as a consequence practically every camp can secure electric power. In view of my recent visit to Kernville, Keysville, Randsburg-Atolia sector, Mohave and Neenach, a description of the country and mining methods employed there will be of interest.

YELLOW ASTER'S tailings dump at Randsburg. The arrow indicates the site of the 1,100-ton mill now being erected to treat the material from it. Construction is reported to be proceeding rapidly

The largest enterprise in the Kernville area is the Big Blue-Summer mine operated by the Big Blue Mining Company. It comprises eight claims, totaling 95 acres, situated about 1½ miles north of Kernville. Development consists of a 400-ft. shaft and a 3,000-ft. crosscut tunnel, with several thousand feet of drifts and crosscuts. The company has recently sunk a new 180-ft. three-compartment shaft and cut a station on the 360-ft. level preparatory to the comprehensive plan of development now in progress. Vein quartz is mineralized with pyrite, arsenopyrite, galena, and sphalerite. The ore, mined by shrinkage methods, is hard and tough. It is hoisted through the new shaft, and trucked to the 125-ton flotation plant situated a quarter mile distant on the right bank of Kern River.

At the crushing plant the ore is passed over a steel grizzly, spaced 10 in., the oversize going to a No. 8 Traylor gyratory crusher to be reduced to 1 in. Grizzly undersize and the crusher product are stored in a 300-ton capacity steel bin, from which the material is fed by a 24-in. belt conveyor to an 8x7-ft. Traylor ball mill operating in closed circuit with a Dorr duplex classifier. The minus-60-mesh classifier overflow is pumped by a 3-in. Wilfley pump to a 5x7-ft. steady head tank before entering the 12-cell Kraut flotation machine. Concentrates from four cells go to two cells used as cleaners, and the product of the remaining

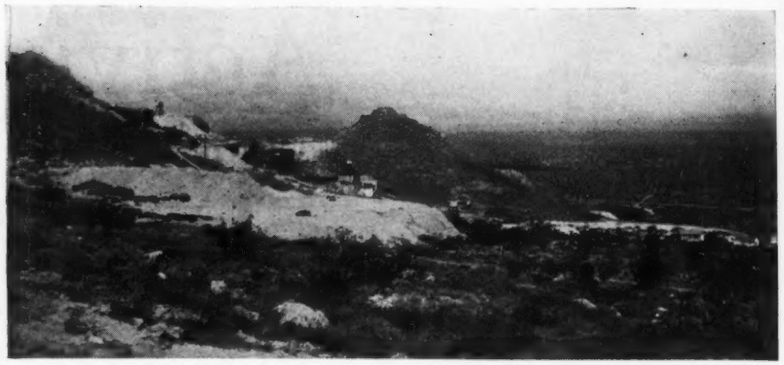
six cells returns via the Wilfley pump to the steady head tank. The cleaner concentrates flow to a concentrates settling tank. Reagents used are pine oil, Z6 xanthate, sodium sulphide, and starch, the consumption being respectively, 0.15, 0.18, 0.17, and 0.015 lb. per ton of ore treated. Ball consumption is 3 lb. per ton. Finished concentrates average $500 per ton, and contain about 33 per cent arsenic. They are shipped to the American Smelting & Refining Company's smelter at Tacoma. Installation of a new hoisting and crushing plant at the new 180-ft. shaft is contemplated. Byron Rowe is general superintendent. About 45 men are employed.

In the neighboring Keysville district, Keysville Sunrise Mining Company, controlled by Pittsburgh interests, is rehabilitating the old Pennsylvania and Sunrise mines with a view of sampling and exploring the old workings and known orebodies. Crews are at work cleaning out and retimbering the 210-ft. shaft at the Pennsylvania mine and the 1,100-ft. tunnel and 150-ft. winze at the Sunrise mine. J. B. Agnew, of 1724 Camino Palmero, Los Angeles, is president of the company, and Phillip B. Heckler, treasurer.

The Drunkard's Dream mine, a comparatively recent discovery, is situated in the Clear Creek district about 4 miles from Havilah. It comprises eight claims, and the camp is at an elevation of 7,000 ft. Three parallel veins occur in granite, which vary in width from 2 to 4 ft. The mine is opened by a 100-ft. shaft and a tunnel, with several hundred feet of drifting on the vein. Ore mined is high grade, averaging $50 per ton in gold. The mine output is treated in a 25-ton mill completed recently. J. C. Walsher and associates, of Bakersfield, are the owners.

Increased activity also prevails in the Randsburg-Atolia mining area. About 4 miles northwest of Randsburg is the Sunbeam property, owned by L. Mills Beam. The mine is still in the development stage. There are fourteen shallow shafts and six inclines at various points on the property, besides the 60-ft. working shaft. Ore obtained from development work is milled in a 50-ton cyanide plant. Power for operations is furnished by a 60-hp. gasoline engine. Eleven men are employed.

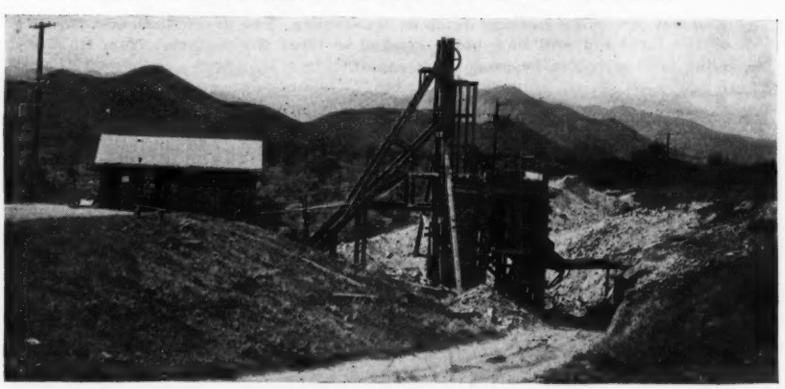
At the famous Yellow Aster mine, at Randsburg, now operated by the Anglo-American Mining Corporation, of San Francisco, underground development continues. Exploration work at the near-by subsidiary, the Big Dyke mine, is yielding good results, and a fair tonnage of ore is shipped to the 250-ton mill at the Yellow Aster. Here fifty 1,000-lb. stamps, plate amalgamators, and flotation equipment, consisting of a 10-cell Kraut rougher and a 2-cell Kraut cleaner machine, are available for milling. The flotation unit has been idle since March, and the ore is treated



SHAFT DEEPENING from 200 to 400 ft. is under way at the Elephant-Eagle, here seen in a distant view on Soledad Mountain, near Mohave. A small crew of miners is working high-grade veins exclusively. The output is cyanided

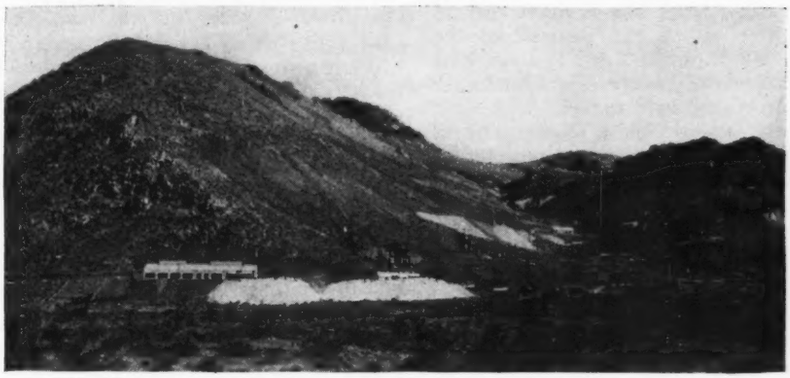
NEAR ATOLIA, the Atolia Rand Placers, Inc., is working a gold and tungsten placer. Yardage is said to equal 1,800,000 and the average value of the gold alone to be 75c. The gravel is washed in this 400-ton mill

ONE of the Le Tourneau carry-all scrapers and tractors used by Atolia Rand Placers for mining the gold- and scheelite-bearing gravel on its property. It has a 12-cu.yd. bowl capacity. The gravel is said to be 20 ft. deep



THIS SHAFT of the Big Blue Mining Company, in the Kernville area, was recently completed to 180 ft. It has three compartments. Ore is hoisted through it and trucked to the company's flotation plant a quarter mile away

KING SOLOMON mine and mill, near Randsburg, operated by International Mining & Milling Company. The workings include over 11,000 ft. of drifts and crosscuts. The 50-ton mill uses stamps, amalgamation and flotation



A DISTANT view of the Golden Queen, on Soledad Mountain, near Mohave. This discovery did much to stimulate the gold mining industry in Southern California. A steam shovel is excavating for the foundations for a 300-ton mill

THE SUNBEAM, 4 miles from Randsburg. The mine is still in the development stage. Ore from this work is treated in a 50-ton cyanide plant. There are numerous other shafts on the property

IN THE Rosamond district, the Tropico Mining & Milling Company is working 11 claims and running a 75-ton cyanide plant. In addition about 35 miners are leasing. Mill capacity is to be increased to 100 tons

by stamps and plate amalgamation. Tailings are expected to be sent to the new 1,100-ton plant now under construction on the west side of the large tailings dump. The foundations for the leaching tanks and machinery have been completed and crews are busy erecting steel, pumps, and other accessories. The sand plant will contain eight 45x12-ft. leaching tanks, with the conventional accessory equipment, while the slime plant will consist of five 60x12-ft. Dorr thickeners, diaphragm pumps and other machinery. Three 14x14-ft. filters, clarifiers, and other precipitation equipment will be installed at the precipitation plant. The mill is treating a little over 100 tons of ore a day at the present time. A. W. Frolli is general manager.

Other properties active in the Randsburg district are the California Rand Silver, King Solomon, and G. B. & Windy mines. All are within a 3-mile radius from Randsburg. As known, California Rand Silver mine was the largest single producer of silver in the United States until 1930, and was acquired by Kelly Gold and Silver Mines, Inc., early in 1933. It is served by a 1,442-ft. vertical shaft and a 250-ton mill is available. In the mine six sets of leasers are working on the 400, 800, 1,000, 1,100 and 1,200-ft. levels, mined ore being shipped to the Selby smelter. The mill is now idle. Frank Royer, general manager, is in charge.

The King Solomon and G. B. & Windy mines are owned and operated by the International Mining & Milling Company, A. G. Ilseng, president. The former is served by a 580-ft. 45 deg. incline shaft, and has underground development work consisting of over 11,000 ft. of drifts and crosscuts. About 30 men are working on individual leases on the property. The 50-ton mill is treating about 25 tons of ore per day. It contains fifteen 1,000-lb. stamps with amalgamation plates, a 4x6-ft. Traylor ball mill operating in closed circuit with a Dorr classifier, conditioner tank, 4-cell Groch flotation unit, and dewatering equipment. Mill heads average $9.50. Electric power is furnished by a 300-hp. Western diesel engine.

Many prospectors and leasers, who are working small, high-grade veins with good results, are active in the part of the Atolia sector known as the Stringer district. Several prospect shafts are being sunk and on the hillsides trenching and tunnel work is in progress. The largest operation is the Baltic mine, where a 50-ton cyanide plant was started recently. Activities at the Atolia tungsten mine, a Bradley subsidiary at Atolia, are confined to development work on the 1,200-ft. level, and milling ore shipped by leasers. The two-compartment shaft serving the mine is 1,400 ft. deep. Capacity of the mill is 150 tons. Crushing is done in two stages, employing a 10x16-in. jaw crusher and a 3-ft. Symons cone. The

mill contains grinding and screening machinery, jigs and concentrating tables for recovering tungsten minerals from the ore. Concentrates receive final treatment in a Herreshoff roasting furnace and magnetic separators. A 65 per cent WO_3 product is made. The company has eight men on the payroll.

About 1½ miles south of Atolia, the Atolia Rand Placers, Inc., is exploiting a gold and scheelite-bearing placer deposit in a unique manner. The gravel, averaging 20 ft. in depth, is removed by LeTourneau carry-all scrapers of 12-cu.yd. bowl capacity operated by tractors and conveyed to a central mechanical screening and concentrating plant of 400 tons, capacity. The deposit is said to contain 1,800,000 cu.yd. of gravel, averaging 75c. in gold. In the mill a revolving trommel, vibrating screens, jigs, and centrifugal concentrators are employed to separate gold and scheelite particles from the gravel. Fine tailings flow to a dewatering plant, to which a large circular tank is now being added. Power is furnished by a Fairbanks-Morse 360-hp. diesel engine. Harry Irwin, Los Angeles, is president.

Mohave Area Active

In the Mohave area, activities on Soledad Mountain, about 6 miles southwest of Mohave, and on Middle Buttes, a group of flat-topped hills lying 4 miles west of Soledad Mountain, continue to hold the interest of California mining men. Especially the discovery made by Clyde Garrett, of Reno, Nev., on March 12 while prospecting on Middle Buttes is causing considerable excitement. Although it appears to be as yet a gold impregnation without a definite vein system, the prospect bids fair to become a substantial producer with further development. Late in March, a lease was acquired by Walter E. Trent, who has several crews at work extracting ore ranging in value from $30 to several hundred dollars per ton from shallow glory holes and tunnels. Preliminary work was started on or about March 18, and during the 16 days preceding my visit (May 3, 1935), 17 carloads averaging $200 per ton has been shipped to the smelter. Mining men are watching with keen interest the outcome of deeper development now in progress to determine the size and character of the orebody. Surface work completed recently includes an automobile road to the mine and a wooden ore storage bin.

Development work similar to that at the Trent lease is in progress at the adjoining Brite-Burton-Westfall lease. Here float containing high values in gold was found following the strike on the Trent property, and several hundred tons of ore ranging in value from $25 to $50 per ton mined from glory holes have been shipped to the Burton custom mill at Rosamond in the past few weeks. Small lots of 75-oz. ore have been encountered occasionally. A one-compartment shaft has been started by the owners near the Trent lease boundary line. As yet no definite vein has been discovered on the property.

About 1½ miles northwest of the Brite-Burton-Westfall lease, two prospects—the Cactus Queen, owned by Kimball, Kempe & Pratt, of New York, and the Blue Eagle, operated by Otto, Wright & Wyman—are in the course of development. At the Cactus Queen the one-compartment shaft has been deepened to 100 ft., from which a crosscut is being driven. The 14-ft. vein cut recently in this crosscut is not of commercial value, but it is expected that a pay-ore shoot will be developed on drifting southwesterly from the shaft. In consequence, a drift has been started in this direction on the footwall of the vein. Major Julian Boyd, Los Angeles, is consulting engineer. The Blue Eagle mine is opened by a tunnel.

At the famous Golden Queen mine on Soledad Mountain, acquired recently by the Golden Queen Mining Company, subsidiary of Consolidated Goldfields of South Africa, a 3,000-ft. tunnel, 8 ft. by 8 ft. in the clear, is being driven at a point 600 ft. below the discovery shaft. It will be the main haulage and supply level of the mine. Monthly advance is about 650 ft., and on May 3 the total length reached was 1,350 ft. At the portal an all-steel combination compressor house and repair shop, a warehouse, and a change house have been erected. Camp buildings consisting of several modern stucco houses for company officials, a staff house and a general office are nearing completion.

The 300-ton cyanide mill now under construction is just below the compressor house. Here the ore is to be ground to 2 per cent on 150 mesh by three Marcy No. 67 ball mills, two of them in closed circuit with a Dorr type DSF classifier equipped with variable speed drives, and the third in closed circuit with an 8x30x12-ft. Dorr bowl classifier of the turret type, equipped with variable speed drives for bowl and rakes. This arrangement will permit either single, two-stage or three-stage grinding. At the cyanide plant four stages of agitation will be carried out in Dorr agitators, four stages of counter-current decantation in Dorr centerpier thickeners, each 55 ft. in diameter, and one stage of filtration in an Oliver filter.

Elephant-Eagle Sinking

Activity at the adjoining Elephant-Eagle mine is centered in sinking the Elephant shaft an additional 200 ft. to 400 ft. The company has a small crew of miners working high-grade veins exclusively, the output being treated in a Gibson mill near the cyanide plant. The returns from this mill have been about $50,000 during the past year. About 35 men, who have individual leases, deliver broken ore to the 75-ton plant. This contains a rod mill, Allen amalgamators and traps, classifier, corduroy tables, and auxiliary equipment. Tailings flow by gravity to the cyanide plant, where the sands are leached and the slimes agitated. At present the mill is treating about 50 tons of ore a day. Installation of flotation equipment is planned. The property is under lease to Jesse Knight, of Salt Lake City, and L. C. Penhoel is in charge. Continental Diamond Drill Company, of Los Angeles, has a drill in operation on the Santa Ana and Starlight claims of the Elephant-Eagle mines.

The Hope Lease

The neighboring Hope lease is operated by the Desert Gold Mining Company, a closed corporation. Development consists of a 500-ft. tunnel, in which drifting and crosscutting operations are in progress. Ore from development work is milled in a 30-ton flotation plant. Ten men are employed under the direction of W. J. Kurt, manager. Considerable development work is being done at the Soledad Extension mine, adjoining the Hope lease, where 20 men are employed under the direction of E. E. Whiteley, manager. The property is controlled by Senator Key Pittman and associates. The mine is opened by a 200-ft. shaft, and about 1,000 ft. of underground work is done a month.

In the Rosamond mining district, the Tropico Mining & Milling Company, headed by Clifford Burton, is operating the Tropico mines and a 75-ton cyanide mill. The property consists of 11 patented claims situated 5 miles northwest of Rosamond at an elevation of 2,800 ft. About 35 men are working individual leases in the Home, Fairview, and Lida claims. Production from the Fairview mine is 20 tons a day. The mill contains 10 stamps fitted with 4-mesh screens, two ball mills, amalgamators and cloth tables, and leaching and agitating equipment in the cyanide plant. It is running at a capacity of 80 tons a day on ore received from the Tropico mines, Mohave, Middle Buttes, and Neenach districts. The company plans to increase the mill capacity to 100 tons.

Development work continues at the Roger-Gentry property, about 4 miles southeast of Neenach and 25 miles west of Lancaster, where six men are employed at the Roger-Gentry mine and seven men at the Russell-Myler lease. The entire holdings consist of 160 acres. Since discovery in 1934, production from both properties has been over $100,000. Development at the Roger-Gentry consists of a 250-ft. tunnel and a glory hole. The Russell-Myler lease is worked through a 150-ft. incline shaft from which about 400 ft. of drifts and crosscuts have been driven. About 20 tons of $40 ore is shipped daily to the Burton Custom mill from the Myler lease.

NEWS OF THE INDUSTRY

"Skeletonized" NRA No Aid To Metal-Mining Industry

Tri-State Lead and Zinc Mines Troubled by Labor Strikes—Copper Industry Desires to Keep Code Without Violating Anti-Trust Laws—Annual Assessment Work Suspended for One Year

ENACTMENT of the "skeletonized" NRA on June 14 left it clear that the natural-resource industries would have to operate within existing laws. Inasmuch as lead and zinc codes did not touch on price fixing, this was no particular hardship to this group, but in copper, because of the marketing provisions incorporated in the imposed codes, the new conditions caused widespread confusion in the industry.

In the Tri-State district national guardsmen are still in the Kansas and Oklahoma mine fields. General quiet and peaceful picketing continue, and most of the miners are working. It is hoped that peaceful conditions will continue after the guardsmen leave the fields.

The United States Copper Association, representing all of the producers and custom smelters of copper within the United States, had several meetings during June. The members of the Association hope to solve the problem of maintaining the price level of copper and the existing labor and wage scales, as formerly under the now defunct NRA. On June 17 the Association unanimously voted to take up the function of the former Code Authority in so far as liquidating all unfinished business of the Code Authority at the time it ceased to function. The Association would, in so far as it might be advised it was legal and proper so to do, cooperate in maintaining the existing standards and practices. The third resolution was to appoint a committee to study and report the extent to which future cooperation is legal and proper.

On June 25 the Association met and elected as president E. T. Stannard, president of Kennecott Copper Company. C. F. Kelley, president of Anaconda Copper Mining Company, was elected vice-president. Louis Cates, president of Phelps Dodge, was also elected vice-president. R. R. Eckert was elected secretary-treasurer.

The chief objective of the Association is to gather statistics pertaining to the domestic copper market.

On June 13 the President signed the bill providing for the suspension of annual assessment work on mining claims for the year ending July 1, 1935. The bill approved is the same in form as when passed by the House of Representatives and concurred in by the Senate. The only difference from last year's enactment is that the current law does not apply to Alaska, the change having been made at the request of Delegate Dimond, of the Territory.

The skeletonized NRA bill which the President signed June 14 is a measure continuing the Recovery Administration but shearing it of authority over codes, wages, and hours in conformity with the Supreme Court decision in the Schechter case. The Recovery Administration will now become a research organization whose chief function will be to collect data on labor and competitive practices of codeless industry and compare those data with conditions existing under the codes.

President Roosevelt signed the joint resolution June 28, extending the so-called nuisance taxes for a period of two years, beginning July 1, 1935. Included in the group of commodities taxed under this resolution is copper, assessed at the rate of 4c. per pound. The revenue obtained from imported copper has been negligible, the total collected since the Revenue Act became law, June 21, 1932, being placed officially at $1,978,665. Most of the revenue was obtained from copper that was imported in the refined condition.

Tri-State Strike Broken

Members of the Mines, Mills and Smelter Workers Union Sign Agreement With 33 Operators—National Guardsmen in Kansas and Oklahoma

THE beginning of the sixth week of the strike which started on May 8 in the Tri-State area found 40 of the 54 mills again in operation, employing about 85 per cent of the 4,200 men previously thrown out of work by the strike. Two weeks of striking brought 1,800 men signifying their willingness to return to work on a pre-strike basis. The movement culminated into the formation of the Tri-State Metal Mine and Smelter Workers Union.

The efforts of this group to interest men to return to work resulted in one instance in an attack by strikers upon peace officers and a mine operator in Picher on May 27. News of this act brought 2,000 back-to-work miners from Miami to Picher with the intention of retaliating for these attacks. The mob was scattered by tear-gas bombs before violence was committed. National guardsmen were called to Picher, thereby relieving a tense situation. Zinc buyers began loading ore on May 30 for the first time since the strike. Picketing by the International Union of Mine, Mill and Smelter Workers was peacefully maintained.

In Kansas, the Beck Mining Company endeavored to reopen a tailing mill on June 8, but shut down when a large group of strike sympathizers gathered. Truck drivers were pulled from their loading trucks at the mill and abused. National guardsmen were called, and, while en route to the strike zone, strikers dynamited two steel transmission towers. Electric current to the mines and communities was supplied after a delay of only two hours.

National guardsmen on duty in both the Kansas and Oklahoma sections created a peaceful atmosphere, and many miners returned to work. The new Tri-State Union built an organization of about 4,000 men in less than ten days. It has signed agreements with 33 operating companies and this result indicates the strike is broken and that operations will resume as heretofore.

Utah Miners Given Wage Increase As Metal Prices Improve

Opening of New and Old Mines Indicates Steady Development of Mining Industry—Leaders Active at the Yankee Mines

WAGES of mine, mill and smelter workers were increased in Utah, effective June 1, 25c. a day. Approximately 6,000 employees were affected by the increase given as a result of the improvement in metal prices.

Several claims were sold by the New Park Mining Company for $50,000 to the Park City Utah Mining Company. In the Mayflower tunnel of the New Park company, at a point about 4,200 ft. below the surface, high-grade ore is beginning to show in the face. The character of the formation is said to be similar to that existing where Park City Utah Mining is developing its orebody from the Star of Utah tunnel. A. C. Ellis, Salt Lake attorney, was added to the board of directors.

Park Utah Consolidated Mines, according to Oscar N. Friendly, general manager, has started work in the North crosscut from the Ontario No. 2 drain tunnel to develop the East Crescent, a productive vein in the adjoining Park City Consolidated property. By agreement Park City Consolidated is driving on the silver vein in Park Utah Consolidated ground to connect with the North crosscut from the Ontario tunnel for drainage purposes. Enlargement of the Ontario drain tunnel channel to carry waters from the Park City Consolidated mine has been completed. A small compressor has been installed at the mouth of the Ontario tunnel to supply power for prospecting the two fissures productive in the adjoining Park City Consolidated.

Eureka Lilly has struck an orebody on the 1,400 shaft level assaying a half ounce of gold per ton.

Ben H. Bullock, manager of the Utah Galena property, in North Tintic, reports favorable conditions on the 400-ft. level. Leasers of the Eagle and Blue Bell mine—Jarvis and Carlson—recently completed the shipment of a carload of ore carrying $14,000 in gold and silver, after deductions for railroad and smelter charges.

Utah Central shipped a carload of gold-silver-copper ore valued at $24 a ton. This ore was taken from the Marietta claims of the property, situated in the Drum district 35 miles west of Delta. Leasers are shipping from the Ibex claims. Work in the Copperhead shaft has been stopped with the exception of drifting operations on the 500 level.

Activity in the Alta-Cottonwood district registered an increase with the reopening of roads after the winter lay-off. Shipments of ore carrying 36 per cent lead and 16 oz. of silver to the ton have been started from the Cardiff mine. Operations have been resumed at the Howell mine, where the company has secured a lease on part of the American Metals property and the right to work through the American Metals tunnel. Dennis Ryan and Frank M. Maloney have taken a lease on the Alta Tunnel property, where mining and milling operations are to be resumed.

Operations have been resumed at the Alta Champion, Flagstaff and Columbus-Rexall properties.

At the Yankee Mines property of American Smelting & Refining, leasers have put the old concentrator in condidition preparatory to operation this summer. Regular shipments are being made from the mine.

Victor Bray and associates shipped a carload of ore from the Charm property, in the Drum district, carrying 1 oz. of gold to the ton.

Utah Metals & Tunnel Company, at Bingham, reports gross ore sales of $54,081 for the year ended Dec. 31, 1934. Part of the property has been leased to American Smelting & Refining, which has sunk a three-compartment shaft to develop the lower horizons. Drifting has been started from the 1,537-ft. level.

R. H. Mesa, of Salt Lake City, is reopening the old Lady Belle mine, at Eagle, Colo. Work will be started in the Mock or lower tunnel.

The 50-ton milling plant of East Standard Mining has been started at Midas, Nev., according to Harry S. Joseph, manager, of Salt Lake City. A tunnel is being run to develop the downward extension of ore opened up in the upper levels.

ARIZONA

• American Smelting & Refining is planning a cyanide annex to the 100-ton flotation mill at the Octave mine. The mine, developed by 5,000 ft. of workings to a depth of 1,100 ft., is under the supervision of M. E. Pratt.

Golden Eagle mine, in the Cherry Creek district, has been opened by shaft and tunnel to a depth of 150 ft. Though operations have been intermittent in the past, an extensive development program is planned, including the sinking of a new shaft.

Comstock-Dexter Mines, at Hillside, has sunk the three-compartment shaft to 400 ft. Three levels are being opened to provide sufficient ore for the projected mill. T. F. M. FitzGerald, president of the company, is acting as general manager during the development campaign.

Lessees at the property of Belmont Copper, Superior, are shipping about 25 tons of gold-silver ore daily to Magma smelter.

Tiger mine, southwest of Aguila, started treating ore the latter part of May in a stamp mill and cyanide plant. Mining and milling are under the direction of A. C. Campbell. In the same district, the Molly Davenport is being opened by W. H. Davenport, one of the owners. A shaft to be sunk to the 150 level is down 40 ft.

Amarillo Gold Mining has sold its holdings to W. J. Blake, who is sinking a two-compartment shaft on the vein.

Overman Mining is planning a shaft to the 600 level at the property near Oatman. The mine was formerly part of the United Eastern holdings. Nielson L. Wagner is directing operations, with Frank Warning in charge of shaft sinking.

A change in plans has been announced by Portland Mines, in the Katherine district. Instead of constructing a 50-ton mill, as announced last month, they will truck ore to the Gold Standard. The contract for the 14-mile road has been let. At present, the 300-ton mill will be able to handle the additional ore, but plans for increasing capacity are being considered. Two shippers to the Gold Standard, the Minnie and Tyro, received electricity last week over the new power line which cuts off near the Roadside mine.

Federal Judge Jacobs refused to declare National Gold insolvent in view of the trustees' report on creditors' claims and stockholders' interests. The 250-ton mill was shut down in 1934 due to drought conditions. W. W. Linesba, president, will present a reorganization plan which he hopes will permit resumption of operations next month.

The Morning Glory and High Grade gold claims, east of the Verde river, 12 miles from Payson, have been leased to W. D. Boardman, who has dewatered the shaft in preparation for development. Grand Prize mine, below the East Verde bridge, has been purchased by the Snell Mining Company, of Miami, Fla. The 125-ft. shaft is being cleaned out. The property has not been worked for 34 years.

More than 5,000,000 lb. of copper have been recovered from the clean-up of the Copper Queen smelter since operations at Douglas were transferred to the Calumet & Arizona smelter. The principal yield has been from the reverberatory furnace bottoms.

The largest blast in Southwestern mining broke an estimated 400,000 tons of rock at the New Cornelia pit at Ajo on the morning of June 2, when 55 tons of dynamite in charges of ½ to 2½ tons was set off.

A strike was called at the Copper

Queen branch of Phelps Dodge on June 10 by the Bisbee local of International Mine, Mill, and Smelter Workers Union. Only 72 men of the 1,100 employed failed to report for work. Numerous fist fights occurred the first few days of the strike as picketing was attempted. The strike was called for the purpose of forcing union recognition.

A gold discovery has been reported from the White Tank mountain district, near Buckeye. Several groups of old claims have been taken over for development, as well as the current strike.

Big Hill Mining, west of Date Creek, is now shipping high-grade silver ore carrying some gold. The property has been under development for several years, with the result that a large body of milling ore is reported in addition to the high-grade.

International Smelting's Miami branch has announced that sulphide ores will now be purchased from the small mines in the district. This is expected to stimulate production from properties in which the values are too low to stand trucking charges over the mountains to Superior.

Samoa Gold is now shipping from the mine in the Cerbat Mountains, east of Chloride. Output has been restricted in the past, due to the necessity of packing the ore down the mountain on burros. With completion of the road, plans are being made to dewater the levels below the present workings on the 200.

Arizona Golden Wonder Minerals has purchased the Dick Lamson mine, 25 miles northwest of Wickenburg. The new owner plans a 50-ton mill for this old property.

Golden Turkey, near Canon, on Turkey Creek, is milling 10 tons of $100 ore a day. The adjacent Golden Belt is also producing regularly. Silver Bar is doing development work.

North Bonanza, Junietta, and Herschel mines, at Tombstone, are being reopened. Another silver mine, the Diamond Joe, in the Wallapai district, is yielding high grade from an old tunnel.

Due to increased ore shipments from leasers, the capacity of the Tom Reed mill is being increased. Foundations have been poured for a 50-ton ball mill and a classifier has been ordered. Both are expected to be in service by July 15.

The Cornwall Mining Company has shipped two cars of gold and silver ore from the Buckeye claims, located 15 miles north of Kingman. While driving a tunnel into the Buckeye claim, a new vein was discovered 650 ft. from the portal. A 50-ft. winze has been sunk on this vein, followed by some drifting. This development revealed ore containing wire silver. At present the bottom of the winze is 270 ft. below the surface and will be deepened.

Leonard Jones, of Chandler, has leased the mill at the Goldfield Mines, located 20 miles east of Mesa. He will mine the ore from his Sterling claims between Miami and Superior and haul it by truck to the mill.

Como Mines, in Nevada, Start New Flotation Mill

Several New Mills Are Under Construction Throughout State—Old Mines in Austin to Be Opened—Building of Water Lines Important

ON JUNE 21 a 350-ton flotation mill started crushing ore at the Como Mines property, 8 miles south of Dayton, in Lyon County. Two 8x8-ft. laterals from the Boyle transportation and drainage tunnel have been extended in the Como, Rapidan, and Yerkes veins, developing a reserve estimated at 1,500,000 tons of mill ore.

Austin Silver Mining is opening old mines at Austin that were notable producers in the '70s and '80s. A long tunnel is being reopened and the Belle Wilder shaft is being equipped with an electric hoist. A millsite has been surveyed and the working force has been increased. Work is directed by F. Sommer Schmidt, resident engineer. R. M. Atwater, Jr., is president of the company.

Arizona Comstock, operating the Savage, Hale & Norcross, Chollar and Potosi mines on the Comstock lode, at Virginia City, is treating 350 tons per day in its flotation mill from a huge open cut in the outcrop of the lode, 317 ft. wide at this point. Recovery of gold and silver from the highly oxidized ore by flotation is low. The 500-ton cyanide leaching plant will soon be completed. Capacity of the flotation mill will be increased in the near future.

Consolidated Coppermines, at Kimberly, near Ely, which was granted a $3,000,000 RFC loan some time ago, will provide title insurance in lieu of an abstract of title covering several hundred lode claims. J. B. Haffner, manager, has indicated that the first work to be undertaken will be to provide a 10-mile water line. He estimates the present reserve at 35,000,000 tons, based in part on the results of a diamond-drilling campaign recently concluded.

Gold properties at Weepah, northern Esmeralda County, formerly embraced in the Electric Gold group but separated by litigation, have been merged in options secured by Walter Haggerty and New York associates. An 8-mile water line is being laid to the mine and a 250-ton flotation and amalgamating mill will be built at once. Sampling and mill tests were made under the direction of H. C. Carlisle, W. V. DeCamp, and Erich Shrader.

New York and Boston groups have undertaken refinancing of Gold Circle Mines, under the new name Gold & Silver Circle Mines, Inc. Noble H. Getchell continues as manager and has been made president. The company owns several gold properties at Gold Circle, Elko County, including the Elko Prince, and the Betty O'Neal silver mine, in Lander County. In both districts new work is to be started, the Betty O'Neal 250-ton flotation mill is to be reconditioned, and the Gold Circle 75-ton cyanide mill will be enlarged. A long tunnel will be driven to cut the Gold Circle veins at substantial

Storage-battery locomotives bring coarse ore to two bins each of 400 tons' capacity at the Como Mill, in Nevada. Crushing consists of jaw and gyrosphere crushers. Fine ore passes to the flotation plant by conveyor belt and shuttles to two 600-ton fine-ore bins. Vibrating feeders, ball mill, and amalgator, rake classifiers, flotation machines, and drum filters are part of the plant design. The mill was designed by Archer E. Wheeler, of New York, and construction was directed by E. L. Sweeney, of Denver

depth, and the Elko Prince shaft will be deepened.

High-grade ore containing electrum has been opened on the 300-ft. level of the Dawes Gold Mines property, at Scossa, northern Pershing County.

A 4-ft. vein was recently discovered in the Ten Mile district, northwest of Winnemucca. The vein has been opened up to a depth of 15 ft. by W. S. Jones and James Burke, and gold ore assaying $30 per ton is reported. This district has yielded rich ore from shallow workings, but this discovery was made beyond the old mineral belt.

The cyanide mill of the Nevada State Gold Mines Company, at Seven Troughs, has resumed operations, treating an average of 110 tons of dump ore per day. Later the mill will treat ore mined by leasers.

Operations have begun on the Rye Patch Gold Mine, recently taken under lease and option by Henry Wirz and associates. It is said sections of the mine will be open to leasers for development and exploitation.

The Ingalls and Jaggers gold properties, in Tule Canyon, have been taken under bond and option by J. F. Trane, of New York, and associates. Years ago this group of mines produced gold ore. It is reported that certain areas of the mine contain ore already blocked out, averaging in value between $16 and $18 a ton.

California Lode and Placer Mining Up

Shaft Sinking, Rehabilitation of Old Mines, and Construction of New Cyanide and Flotation Plants Make Mother Lode a Busy Place

OPERATIONS continue to expand in the Grass Valley-Nevada City area. Idaho Maryland Mines Corporation is installing a new Marcy ball mill at the Brunswick mill to raise its capacity to 300 tons a day. With 300 and 100 tons of ore being treated at the new mill, built last year, and at the old Idaho mill, respectively, the latter reducing ore from the Bullion mine exclusively, total daily production is now 700 tons.

About 350 tons of ore are being milled at the Empress mine, in the Newtown district, owned by Republic Gold Mining, following the installation of a new 75-ton ball mill. Lava Cap Gold Mining Corporation is reported to have started sinking the Central shaft an additional 200 ft. to 1,600 ft., as a preliminary to contemplated development work at that depth. The mill is treating over 200 tons of ore a day. The company is operating the Banner and Central mines, near Nevada City, with Otto E. Schiffner in charge of operations.

Rehabilitation work is progressing satisfactorily at the Presscott Hill mine of Empire-Star Mines, where a new surface plant and hoisting equipment were erected recently. The company is also making several improvements at its Empire and North Star units. At the Empire mill several tanks are being added to increase the capacity of the cyanide plant, and a new ball mill and flotation equipment are to be installed at the North Star mill. Electrification of the main North Star hoist, which involved the installation of a 500-hp. motor and enlargement of the hoist house, was completed early in June.

At the Spring Hill mine, Grass Valley, work on the new surface plant is progressing under the direction of H. R. Plate, manager. Buildings completed include a new office, repair shop, and change house. The foundations for the steel headframe and a 100-ton flotation plant, to be built under contract by Western-Knapp Engineering Company, are ready to receive the superstructures and machinery.

The new air shaft sunk about half a mile east of the Idaho shaft by a special shaft-boring machine invented by J. B. Newsom, of Palo Alto, Calif., has reached a depth of 523 ft., and the device is reported to perform satisfactorily as to drilling speed and costs. It consists of a circular drive head powered by a 40-hp. motor, and a steel-core barrel measuring 5 ft. in diameter. Drilling speed in normal ground is 10 in. per hour. No. 6 chilled shot is used in drilling operations. Cores up to 8 ft. in length have been extracted with a special core puller. The working crew consists of two men.

In the Penryn district, near Auburn, the Chicago-Auburn Mining Company is milling about 35 tons of high-grade ore a day, the mill equipment consisting of a Forrester-Rexman rod mill, three Fagergren flotation cells, a concentrating table, and amalgamation equipment; and the Alabama Mining Company is adding ten stamps and concentrating machinery to the present mill to increase capacity to 75 tons. Arthur Sweet is manager at the Chicago mine, and M. Webber directs operations at the Alabama mine.

At Greenwood, T. W. Carpenter, of Pasadena, is erecting a 300-ton cyanide plant to reduce ores mined from an open pit by a dragline at the Greenwood Quartz mine. The mill building has been completed and erection of machinery and tanks is in progress. Equipment at the mill includes a ball mill operating in closed circuit with a single-rake Dorr classifier, a regrinding unit, and a pulp-sifting table. Grinding will be done in cyanide solution, and counter-current decantation will be employed at the cyanide plant proper.

Good progress is being made in the Beebe mine, at Georgetown, in sinking a 79-deg. inclined shaft, located about 100 ft. from the present working shaft. Sinking will continue to the 500 level. The portion of the shaft raised from the 250 level to the surface has been timbered and the collar concreted, and erection of a 56-ft. steel headframe is to start as soon as the foundations are completed. Meanwhile, crews are at work completing the remaining portion of the shaft by sinking from the 250 level and raising from the 500 level.

The new crushing and grinding plant now under construction will have a capacity of 50 tons per hour. Mine-run ore will be reduced to ¾-in. in two stages by a 24x36-in. A-C jaw crusher and a 3½-ft. Traylor gyratory crusher, and transported to two 180-ton steel storage bins by a belt conveyor system. Equipment at the fine grinding plant includes a 20x5-ft. Hardinge-Hadsel mill and a 7 ft. by 36 in. Hardinge ball mill, both operating in closed circuit with a Hardinge counter-current classifier, and a second 7 ft. by 36 in. Hardinge ball mill with a Dorr classifier. The 65-mesh overflow will be treated in Kraut flotation machines and concentrates cyanided at respective departments at the mill. During construction the mill is operated at a capacity of 100 tons a day, with 50 tons of ore being received from the Alpine mine. About 55 men are employed, under the direction of L. E. Putnam, superintendent.

Activities at the Union mine, near Placerville, are centered in sinking the shaft to 2,000 ft., and lateral development work with diamond drilling on the 1,200- and 1,600-ft. levels. At the Big Canyon mine, 4½ miles south of Shingle Springs, the main shaft has reached a depth of 565 ft., with sinking operations still in progress. The 300-ton flotation mill is operated at capacity.

Yuba Consolidated Goldfields has placed in operation a new 9-cu.ft. dredge near Biggs, Butte County, where the company has extensive placer holdings. Construction on the Biggs unit started last fall.

Installation of a 50-ton mill, containing a 9x3-ft. Hardinge-Hadsel mill, two amalgamating tables, and Kraut flotation cells, has been completed at the Draper mine, near Soulsbyville, owned by the Draper Vein Syndicate. Ore is mined from the 300, 400, 500, and 600 levels, with development work in progress at various points in the lower levels. The mine was rehabilitated in 1934, and is developed by a 600-ft. shaft and extensive lateral work. J. O. Gillice is in charge of operations for the company.

Milling operations have been started at the Black Oak mine, in the Garden Valley district, El Dorado County, discovered in 1933 and now operated by R. J. Wilson and E. W. Wilson.

NEWS FROM WASHINGTON

By Special Correspondent

ADMINISTRATION AMBITIONS to federalize industry control remain unabated. Means for realizing these ambitions are, however, hard to find. But New Dealers still seek diligently for them despite the all too obvious handicap imposed by the sweeping Supreme Court decisions of May.

The honor system of code observance was grudgingly adopted by the President with the open expression of opinion that he did not expect it to work. Quite to the surprise of Washington, almost to the disappointment of New Dealers, reports continue of acceptance by manufacturing, mining, and merchandising agencies of wage, hour, and other labor restrictions which were first adopted only under duress. Cynical Washington observers are disposed to say that business exhibits more statesmanship than Washington officials. But the truth of the matter is that employers of any substantial number of workers are glad to continue these regulations so long as their competitors will, because business apparently has definitely concluded that profits and prosperity depend more on adequate employment and generous wage scales than on any other controllable factor. In the meantime workers are hoping there will be no occasion for strikes.

Silver Prices

TREASURY OFFICIALS have talked back with unexpected rudeness to silver Senators lately. Some even charge the Treasury with deliberate effort to force decline in silver prices. If the latter could be proved, it would make a No. 1 enemy for the silver state bloc of legislators; and undoubtedly such official, if discovered, would be sufficiently under fire to make his continued control of silver purchasing policies impractical.

This situation can be understood only when one appreciates the solidity of the bloc of 24 Senators and about 75 members of the House of Representatives who from time to time make their silver price demands at the White House and at the Treasury. This bloc has on occasion exercised virtual veto power on legislation which had nothing to do with their states' interest. They took this means of demonstrating their "right" to further consideration for silver or for other subjects of concern to the Western states. As the leader of this bloc, Senator Wheeler, of Montana, is generally recognized as one of the most potent members of Congress, at least so far as power to delay or prevent enactment of measures is concerned.

The Treasury naturally wants to buy all the silver it can at a low price. By that means it would secure the greatest "profit" when the price is ultimately advanced to $1.29, as required by law. Furthermore, by this means Treasury economists well know that they can minimize the ultimate loss which is inevitable in the future when silver certificates must be redeemed after silver prices are again restored to the level at which they will stabilize on the basis of silver as a commodity. These economists do not expect indefinite continuance of silver as a monetary medium at high prices. They do not believe that economically feasible for the United States. Hence their far-seeing planning to acquire the silver at the lowest cost.

Treasury officials would, of course, like to argue that the Western silver producers are getting all the necessary encouragement in the present pegged price for newly mined domestic silver. They believe that any other bonus awarded to this metal becomes simply an invitation to speculation. And naturally, as administrators of the public funds, they dislike the thought of having those speculatively inclined given too easy access to Uncle Sam's purse. If, therefore, the President can get what he wants from Congress through the remainder of the present session without advancing the price of silver again, he will certainly be urged to follow that course by his fiscal advisers. But ultimately the decision on this subject is always political, not economic. Forecasting, therefore, demands an appraisal of motives and intra-party problems which form poor foundation for useful forecasting.

Work Relief Mining

PLANS FOR WORK relief under Harry Hopkins' management undertook literally to accomplish the President's oft-stated plan to create 3,500,000 jobs. To do this with $4,000,000,000 required, by simple arithmetic, the allotment of not over $1,100 per man to be engaged. Thus there was built the highest hurdle yet erected between Santa Claus money and work relief.

All mine projects were obviously thrown out of the window as fast as received when the criterion of $1,100 per man had to be observed literally. Hence no progress was made at all during most of June despite the frantic effort of Bureau officials to devise schemes that would qualify.

The impracticability of this limit roused vigorous criticism in many quarters, notably with PWA Administrator Ickes. He knew full well that worthwhile permanent projects which would salvage some useful things from the spending could not be allocated within that limit per man. Change in policy was indicated among the best informed as early as June 20. How far amendment will go is not evident. But complete abandonment of this yardstick is not expected, and employment in the mining industry will, no doubt, be increased when plans are enacted.

Stopgap NRA

THE SKELETON organization at NRA continues to guard the bones of the Blue Eagle. Reorganization has proceeded slowly since mid-June when the President announced his executive order constituting the new agency as authorized by the Congressional resolution approved June 14. Necessarily vague in its definition of duties and scope, the first announcement established a division of review to gather facts and a division of business cooperation to aid in voluntary code maintenance. But almost before the ink was dry on the commissions appointing the new chief officials, these gentlemen began to talk about further legislation that was needed. Since the early trial balloons did not stir up the anti-aircraft units of industry, it may be expected that some definite steps will be taken before Congress adjourns to broaden the legalized scope of the stopgap organization.

Most important to the mining industry is, of course, the question as to what special authority may be granted for mineral resource industries. Most conspicuous are the Guffey coal bill and the Thomas petroleum measure. But neither of these will be helpful outside of the much troubled fuel industries. And even within those industries they may afford merely an excuse for another series of legal battles by which the New Dealers will attempt to determine how they may control the production and marketing of commodities dependant on limited natural resource. If the courts give sanction to such effort, there is no doubt that similar legislation will follow for all of the major metals and non-metallic minerals. But this effort for other minerals cannot even begin until next year.

The New Dealers have not announced their intention to discipline chisellers by unpleasant methods of public attack. But those plans are clearly being considered behind the scenes. Those who by variation from voluntary code practices incur disfavor in Washington, may, therefore, expect unpleasant com-

ment in a form intended to "encourage" return to the code fold.

Use of the Federal Trade Commission procedure to assist in continuing trade practice control has been generally recommended. At first this idea found no encouragement in official Washington, because of the feud which has existed between NRA and FTC ever since the founding of the New Deal agency. But late in June, finding this intra-Administration controversy was causing real difficulty, the President intervened, and sincere effort is apparently now being directed to using both the remaining NIRA authority and the long existent, fully adjudicated authority of the FTC.

Certain industries will find it particularly advantageous to take the initiative under the old Federal Trade Commission plan. It may not be feasible to secure exactly the old-time Hoover-instituted procedure of trade-practice conferences, but some substantial equivalent will undoubtedly be arranged for the convenience of those who are sincere in the desire to continue voluntary codes.

In connection with these matters of code enforcement, it is important to remember that only strictly interstate matters may be controlled and, under FTC, activity is largely limited to merchandising practices. The two bills in Congress which have been seriously considered for strengthening FTC procedure are not found anywhere on the Administration "must" or "wanted" lists. Hence enactment is highly improbable, during this session of Congress.

Tariff Making

IN EXTENDING present excise and import taxes for two years beyond their anticipated expiration, June 30, Congress has stabilized to some extent the price and competitive situation for copper. Had the four-cent duty on the red metal been discontinued, this would have, of course, completely upset the relationship between mining districts and radically recast the price structure. Even those who normally oppose this tariff in Washington are not particularly anxious to have so disturbing a factor introduced just now. Hence it is not surprising that almost no important voices were raised in opposition to continuance of the four-cent duty for another biennium.

The State Department continues its tariff revision program through the negotiation of bilateral trade agreements. And it is more and more evident as each new agreement is announced that Secretary of State Hull intends to have a general lowering of tariffs even though he must achieve that end piecemeal.

Some Washingtonians believe that by the time a few more of these agreements have been announced there will be sufficient criticism of the tariff concessions so that Congress will have to take notice. The number who so protest, both among industrialists and members of Congress, grows with each announcement. However, there is no likelihood of any change in trade agreement authority in this session of Congress. Hence if Secretary Hull is discreet enough to withhold further announcements until after Congress adjourns in the late summer, he may continue his present plan undisturbed by legislative restriction at least for another six months.

It is not unlikely that in 1936 Congress will tire of listening to complaints back home regarding tariff changes made by the Executive and will decide to reclaim for itself this, at present, legally allocated authority. The root of the trouble, of course, is the fact that relatively innocuous agreements made, with one nation, become quickly dangerous tariff changes under the requirement of our many most-favored-nation treaties. The classic example of this still remains the cut in manganese duty given as a concession to Brazil to the ruination of the Cuba industry, further rattling of the bones of domestic producers, and real aid only to India and the Gold Coast.

Mineral Policy

NO LEGISLATION to effectuate the ideas of the Planning Committee for Mineral Policy should be expected from the present session of Congress. The first report of that committee, necessarily general and not including any specific recommendations for legislation, was announced in January. The supplemental work has not yet resulted in a second report, and will not for some weeks to come. Hence any attempt to formulate legislation this year is necessarily futile.

The second report, when it is done, will, according to Chairman Leith, be in the nature of a second approximation, more definite than the report released in January, but still far from a set of final recommendations. It is planned to have it general in form, rather than particularized with reference to individual metals or minerals. This policy is preferred because it will simplify later legislation and consolidate administrative control in a way not feasible if each commodity were to be covered by the introduction of a separate bill.

It still appears unlikely, late in June, that progress will be made with the McReynolds bill which resulted from the tin inquiry and proposed a Board for Strategic Materials. This general measure has many sharp critics in Washington, and apparently is opposed by all who have been interested except its original proponents. This, of course, foredooms it to failure.

Some of the hesitancy to enact any legislation providing mineral production control comes from the fact that a test case defining the authority of the Federal Government is wanted. Mineral economists believe that a definition of the limits of constitutionality will be had as a result of the enactment of a coal measure, the Guffey bill. That legislation started out largely as a labor control measure, but more and more is becoming one dealing with coal as a resource and defining conditions for its control in interstate marketing. The mineral planners believe that if such scheme will work for coal, and stands a Supreme Court review, then it will be easy to do a similar job for the rest of the mineral industries. So long as the President has so many other more pressing problems on his hands than the problem of mineral policy, he is not likely to bring pressure upon mineral resource planners for any definite action during this session.

Electrometallurgy

ELECTROMETALLURGICAL investigations are to be conducted by the Bureau of Mines with some of the additional funds available for the coming fiscal year. Final decisions as to type of study have not been perfected, but the talk now is that the work will relate to chromium and manganese. The effort on these two metals will have as its objective the development of processes capable of converting what are now uneconomic mineral reserves into workable supplies of these deficiency metals.

In the case of chromite there are large low-grade supplies in the West which, the Bureau hopes, may prove susceptible of electrometallurgical processing with technologic success, even if not with full economic success at the start. The Bureau men point out that if it were known how effectively to recover chromium from these reserves in time of emergency, then at least the nation is protected against short supply, even though the price might under emergency conditions have to be advanced materially.

Studies on manganese methods will be a continuance of the ten-year program of the Bureau conducted during the last decade from which a number of partly successful processes were developed. Changed economic conditions with respect to byproduct recovery, the Bureau officials explain, may now make possible treatment of manganese ores containing silver. With silver at 77 cents to $1.29, some developments are feasible which were out of the question with the 30c. silver price of recent years.

Another project, perhaps third in rank for electrometallurgical study, relates to manufacture of aluminum, magnesium, and potash from Western alunite. Congressional pressure for this investigation is perhaps more important in giving it precedence than either technologic or economic benefits anticipated. But whatever the reasons may be, it is high on the priority list at the moment.

Salmon River Section of Idaho Expects Placer Boom

Sunshine Mining Sinking New Shaft—Small Operations Thriving—Workers Vote Not to Strike at Morning Mine

THE entire Salmon River section is getting ready for the greatest mining boom that has been witnessed for many years. Cars loaded with mining equipment of all descriptions may be seen traveling over the Salmon Highway. Prospectors, experienced and otherwise, are waiting in Challis and surrounding territory for the snow to disappear in the higher altitudes, so that they can take to the hills in search for gold and silver.

Sunshine Mining Company directors have declared a dividend of 30c. per share, payable June 29 to stockholders of record June 15. The disbursement totals $446,646. It is the highest rate ever paid by the company, the first-quarter payment being at the rate of 20c., totaling $297,764.40. This disbursement brings the grand total to $3,174,034. Operations at the mine are on a larger scale than at any time in its history. The estimated goal for the present year has been set by Frank Eichelberger, manager, at 5,000,000 oz. of silver. The mill is handling about 600 tons daily.

An important project under way at the mine is the sinking of a new four-compartment shaft which is projected to the 3,100 ft. level. The present shaft extends to the 2,300-ft. level. The shaft is one of the major operations in the Coeur d'Alene district and when completed will be an outstanding feature of Northwest mining.

Surface plant buildings at the Jack Waite mine, recently destroyed by a fire, have been replaced by modern structures, according to General Manager Washburn. Total damage by fire is said to be about $20,000. About 30 miners are employed in the mine.

The War Eagle mine is employing twenty men and experts to do considerable development work this year.

At the Tiawaka, near Dixie, five men are shaft sinking and doing development work. When the snow melts and the roads are passable many will be attracted to the region to assist in development work on new properties.

There will be no strike among union workers at the Morning mine, in Mullan, according to announcement of George Myott, secretary of the International Union of Mine, Mill and Smelter Workers, on tabulation of the ballots in the recent strike vote, which the union called when demands submitted to the mine management were ignored by H. G. Washburn, general manager.

The Mullan union was the second in the Coeur d'Alenes to vote on a strike, similar action having been taken May 29 by workers at the Sunshine mine.

The Mineral Mountain property, located on Spring Gulch, adjoining the Polaris, will soon be equipped with machinery to work in the deep tunnel, started from the creek level. A compressor, motor, and other equipment have been purchased and will be delivered at the mine soon, according to Fred Thiel, manager. The road to the property is being widened and a bridge built across the Coeur d'Alene River to give better access to the lower workings. Five men are now employed at the property, and it is planned to use two shifts in the tunnel work as soon as the machinery is installed.

Plans are now being made to resume operations at the property of the Rob Roy Mining Company, in the Sunset district. No work has been done for several years. At the time operations ceased a good showing of lead-silver ore gave evidence of widening. The directors have let a 50-ft. contract for additional development.

Development operations have been resumed on the Silver Crescent Mining Company's claims, located in the Moon Creek district. Ross Roundy, well-known mining man, is in charge of the work. The company owns a group of nine unpatented claims. A lower tunnel has been extended 1,000 ft., developing ore said to contain high silver values.

The east drift on the vein of the Bunker Chance property, in the Wardner district, is advancing with encouraging results, according to the management. The drift is along the footwall side of the ledge and has been extended about 125 ft. from the crosscut intersection. Silver values are appearing in the vein in a carbonate formation.

A. H. Moe, manager of the Royal Basin property, in the Beauty Bay district, reports a resumption of activity on the company's claims. The lower tunnel, now in 500 ft., is to be continued for about 150 ft. and will cut the vein at considerable depth. Chief values in upper levels are gold and silver.

MONTANA

• Henderson Mining Company is working a crew of seven men on a gold quartz property about 9 miles above Gold Creek, in the Pioneer district. Ore for shipment from a vein two feet wide assays $60 per ton, according to Robin Stuart Wilson, who is supervising operations.

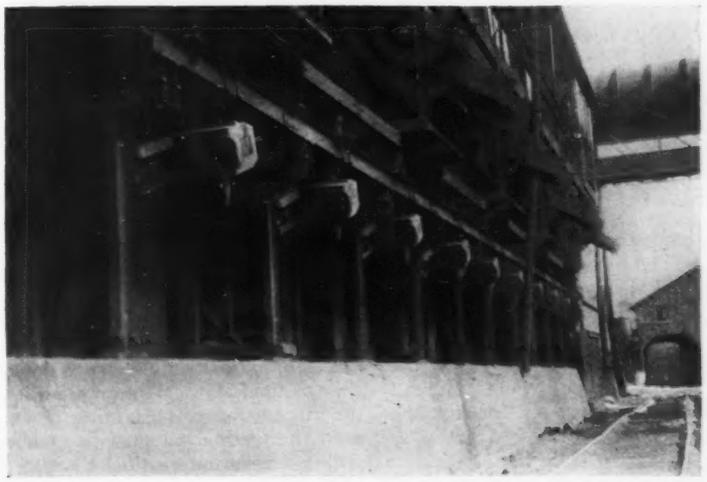
In the gulch adjoining the properties of the Henderson Mining Company, the Pikes Peak Mining Company has twenty men employed on a placer operation.

According to a report made by Rowland King, Spokane mining engineer, the Marietta Mining & Milling Company has blocked out about 29,000 tons of ore with a gross assay value of about $311,000. The property is in Barton Gulch, Madison County. The company's mill is operating one shift per day, and producing about one ton of high-grade concentrates daily.

Montana Consolidated Mines, operating the Spring Hill gold mine and mill near Helena, shipped $26,000 of concentrates in May and $22,000 in April. Mill capacity is 250 tons per day.

The second annual meeting of the

Dust-proof hoppers and emergency car-loading chutes are used on the Bunker Hill & Sullivan's ore bins in Kellogg, Idaho



Mining Association of Montana was held at the Rainbow Hotel, in Great Falls, on June 21 and 22, the principal speakers being John E. Norton, head of the mining-loan department of the RFC of Washington, D. C.; C. E. Julihn, Washington, D. C., of the common metals division of the United States Bureau of Mines; Dr. Francis A. Thomson, president of the Montana School of Mines and director of the Montana Bureau of Mines and Geology.

Resolutions passed call for:

1. Building of roads to mining camps by the Government under the present work-relief act.

2. Sending of a delegation to Washington in an effort to obtain federal aid for Montana mine development. The delegation to consist of E. B. Coolidge, Great Falls oil and mining operator; Dr. Francis A. Thomson; and Carl J. Trauerman.

3. Urging priority of rural electrification projects in farming districts adjacent to mining districts.

MICHIGAN

• At Calumet & Hecla Consolidated's Ropes gold mine property, near Ishpeming, Mich., the main shaft, which has a depth of 813 ft. and 15 levels, has been completely dewatered. Capt. Samuel Richards, in charge of operations, plans to follow a drift on the fourteenth level, which extends 540 ft. to the east, to determine the kind and extent of the ore in this part of the mine. The stopes in the lower workings, which were mined about 40 years ago, are much larger than those in the upper levels, leading to the belief that more gold rock was found near the bottom. An electric hoist has been set up to replace a small steam hoist formerly in operation and an electrically driven compressor and air line to the shaft have been installed.

The Michigan stamp mill, at Keweenaw Bay, Mich., owned by Mohawk Mining, which has been dissolved, is being razed. The mill was built 28 years ago to stamp copper rock from the Michigan mine, in Ontonagon County, but was never used.

IRON COUNTRY

The natural-gas line from Montana to the Minnesota iron ranges has been approved by all communities, towns, and cities through which it will pass and has been submitted for approval to the federal engineer for the State of Minnesota.

The Donwoody mine, at Chisholm, formerly owned by the Pickands Mather Company, has been taken over by the Argonne Ore Company and is producing on a small scale.

More activity is anticipated by the Duluth district of the federal Bureau of Mines, as the appropriation for the new fiscal year was increased $600,000 to a total of $1,970,311.

Quebec and Ontario Mines Operate Under an "NRA"

Quebec to Build New Highway to Northwest Gold Fields—Larger Mill for Buffalo-Ankerite—Lake Shore to Have a New Shaft Rising From the Waters of Kirkland Lake

RECENT NRA findings have drawn attention in Canada to legislation now in force in some of the provinces which is designed to effect some of the same objects as NRA, and which, being on a provincial basis, is secure from interference from legal sources. The pioneer in this respect is the Arcand Act of Quebec, which now has been functioning smoothly and with increasing effect for a year. The newly enacted Industrial Standards Act of Ontario seeks the same results in a somewhat different way. Both aim to raise wages, particularly those in the lower categories, and to control the hours of labor. The law in each case is designed to implement agreements made voluntarily between organized groups of employers and employees in each of the trades.

The Arcand Act preserves to a notable degree the democratic principle of self-rule; and from the experience of the past year it seems that self-rule in industry by this means may become much more effective than is the present-day political democracy. The Act provides that agreements, made voluntarily by a preponderant number of organized employers and employees in any trade or occupation, may be submitted to the Minister of Labor for official approval and put into force. The Minister's duty is to make sure of the good faith of the applicants, that they are truly representative of the trade concerned, and that the measures they propose are in the public interest. The effect so far has been to impose reasonable agreements as to minimum wages and maximum hours on the extremists, whose influence heretofore has been out of all proportion to their numbers.

The Industrial Standards Act of Ontario, recently passed and only now coming into operation, employs to a much greater extent the initiative and discretion of government employees. It is the Industrial Standards Officer, appointed by the Minister of Labor, who summons a conference of employers and employees and it is under his scrutiny and direction that an agreement is worked out. Similarly, the enforcement of the law is in the hands of this public officer, rather than the appointee of the trade concerned, as in Quebec. The Ontario authorities have considered that this method will be more useful under the circumstances pertaining in Ontario than the method adopted in Quebec. It will be very interesting to watch the progress of the respective measures, and thus to determine whether, in this sphere of Canadian life, the democratic or the bureaucratic method is more useful.

ONTARIO

• McIntyre finished its fiscal year on March 31 last with a series of records. It milled 862,100 tons of ore, for a recovery of $7,593,566 (exclusive of $807,999 mint charges and bullion tax), at an operating cost of $4.18 per ton. The profits (before depletion) were $3,691,677, and the net working capital was raised to $9,383,271. The ore reserve was increased to 3,430,481 tons averaging 0.3217 oz., or four years' supply for the mill. With the exception of the grade of the ore reserve, all these figures are records.

The enlarged mill of Buffalo-Ankerite is now operating at 500 tons' capacity, making a good profit from its $7 ore. The adjoining Marbuan mine (formerly March Gold), under the same management, has not yet met with the same fortunate result, the expenses of the limited program of exploration being barely met by recovery from its 150-ton mill. Paymaster Consolidated is operating its 200-ton mill steadily on $7 ore and appears to be well established.

Omega Gold Mines is the name of the new company organized by Castle-Trethewey to operate the old Crown Reserve mine, at Larder Lake. When closed some years ago, the mine was estimated to have reserves of 560,000 tons averaging 0.195 oz. to 1,200-ft. depth. It is expected that this can now be treated for a profit of $2 to $2.50 per ton.

Lake Shore has let a contract to Foundation Company of Canada that is of an unusual nature for a mining camp. Foundation Company specializes in marine construction and caisson work and is now putting in the upper part of a shaft in a caisson in Kirkland Lake. Bed rock is at a depth of 70 ft. at this point in the lake. The larger part of Lake Shore's ore lies beneath the lake, and the present shafts on the shore are not particularly well placed to serve the mine. The new shaft rising from the waters of the lake will therefore provide a considerable economy as well as convenience when it is in operation to 4,000 ft., about three years from now. During the past two years a large

amount of ore has been found in the upper levels close to No. 3 shaft, and when the new shaft is in operation in its place it will be possible to remove this.

Until recently only two of Ontario's silver mines remained in operation—namely, the O'Brien mines, at Cobalt and Gowganda respectively. Now two more are being unwatered, the Violet property of La Rose, at Cobalt, and the Morrison, at Gowganda. It is likely the Keeley and Frontier properties, in South Lorrain, will be merged before being reopened.

Attempts during recent years to reopen some of the old gold mines between Port Arthur and Kenora have not been particularly successful, but at least two, both in the Lake of the Woods area, now appear to be well established. The Cedar Island property of Kenora Prospectors & Miners, Ltd., which includes the old Mikado mine, has shown a moderate volume of high-grade ore to 400 ft. in depth, and work below that level is now in progress. At the nearby Cameron Island property of Dupont Mining Company, ore of similarly high grade and possibly more substantial volume has been found above the 125-ft. level. A 25-ton test mill is being erected for the joint use of these properties, both of which have been financed mainly by Ventures, Ltd. Wendigo Gold Mines, in the same locality, has now 60,000 tons of $12 ore to a depth of 500 ft. and is preparing to install a 50-ton mill.

The district of Patricia, which was practically unexplored ten years ago, now has four substantial mines in operation—namely, Howey, McKenzie Red Lake, Central Patricia, and Pickle-Crow—all at a distance of over 100 miles from the railway. Howey continues to be Canada's leader in low costs, running steadily at $1.85 per ton. Pickle-Crow, on the other hand, is getting close to an ounce per ton from its 100-ton mill. McKenzie Red Lake, about 10 miles north of the Howey, is treating ½-oz. ore, as is Pickle-Crow's neighbor, Central Patricia. Several properties are being actively developed in the Red Lake area, where the gold measures extend for 40 miles or more.

QUEBEC

• The decision of the Quebec Government to build a highway that will connect the gold field in the northwest of the province with Montreal and Ottawa draws attention to both the important present development in the gold belt and its promise for the future. The plan is to complete a trunk road from the present highways northward from these cities to Senneterre, and westward along the gold belt to the existing road at Rouyn. Some short sections of the Rouyn-Louvicourt highway are already built, and contracts have now been let for the larger part of the remainder. This highway, when completed, will run for over 100 miles eastward from the Ontario boundary to the Montreal-Senneterre highway, with branch roads to those mines that it does not run through. Contracts are to be let this year for 90 miles of the Montreal-Senneterre road, but the central part, 60 miles in length, is not likely to be constructed until later.

The 250-ton mill of Lamaque mine, subsidiary of Teck-Hughes, is in steady operation on ore averaging about ⅓ oz. In spite of the erratic nature of the tabular deposits, the management believes that the feed for this mill is secure, and recent developments indicate that a 500-ton mill may soon be warranted. At the Sigma property, near by, where Dome has been getting interesting results, a new shaft and levels to 500 ft. are projected. At the Vicour, Anglo-Huronian is exploring on the 150-ft. level. Perron Gold is installing a 100-ton mill and the adjoining Beaufor has been refinanced for a substantial campaign of development. The Sullivan mill has been doubled in capacity, to 100 tons, and the mine is in splendid condition to feed it with ½-oz. ore. Farther west, at the O'Brien mine, the new hoisting equipment is installed and work is under way toward the 1,000-ft. level. Canadian Malartic's 225-ton mill is now running steadily on $7 ore. Steady progress is being made in the program of underground development at the Mud Lake property of McIntyre, 65 miles south of Rouyn, and on the adjoining properties of Coniagas, O'Brien, and others, surface exploration is under way.

MANITOBA

• Gunnar Gold, whose main vein was faulted above the 500-ft. level, is again finding high-grade ore on its two new levels at 625 and 750 ft. Though the shoots of ore so far disclosed are not large, they will probably be sufficient to feed the 100-ton mill that is being considered by the management. The grade runs from ½ to ¾ oz. across 3 to 5 ft. This property, though in a rather isolated locality, has been notable for the speed and economy of the underground work under the management of James Houston.

The San Antonio mill is operating consistently at 300 tons a day on ⅓-oz. ore, operating costs being kept at about $4.50 per ton in spite of the rather extensive scale of the development work. With the new shaft completed, development on the lower levels and laterally is receiving more attention, and ore is being put in sight much faster than it is milled. On the adjoining Forty-Four property, on the east, results from the long drive from San Antonio have been rather disappointing so far, but a campaign of drilling from this drift has been started in order to get information that may warrant further underground work. At the Cabrielle property, on the west, underground operations have been suspended in favor of drilling.

Last year Mining Corporation acquired the Rex property, at Herb Lake, which was developed unsuccessfully some years ago, and has renamed it Laguna. Drifting on the 300- and 500-ft. levels has now disclosed substantial amounts of ¾-oz. ore about 3 ft. in width.

BRITISH COLUMBIA

• Mineral production in British Columbia during 1934 was valued at $42,305,297 in the annual report of the Minister of Mines, published recently, recording an increase of $9,702,625 over the output in 1933. A further expansion of the industry during the current year is anticipated in the report, although a considerable decline will probably take place in the production of copper, particularly in view of the imminent termination of the Granby Consolidated operations at Anyox.

The strike for higher wages at gold mines in the Bridge River area, referred to in the last issue of *E.&M.J.*, was settled after a period of two weeks' duration by an agreement adjusting the level of wages. The new schedule allows miners $5.40 a day, muckers $4.50, and ordinary laborers a minimum of $4 a day. Thus is established a wage scale altogether out of line with scales prevailing elsewhere in the province and in other parts of the Dominion. Properties in the development stage consider the new scale too high, and several of these have suspended operations pending the findings of a Conciliation Board investigating under the provisions of the Industrial Disputes Act.

Reports presented at the recent annual meeting of Pioneer Gold Mines, Ltd., described in detail the splendid results obtained at the mine during the fiscal year ended March 31 last. Of the $3,079,790 of gold and a small quantity of silver recovered from 130,545 tons of ore milled, $1,593,641 was earned as net profit, of which $1,313,813 was returned to shareholders as dividends. The mill operation was entirely satisfactory, recovery amounting to 96.93 per cent and cyanide consumption being reduced materially. Mill heads averaged 0.6856 oz. gold per ton. Development work, exclusive of shaft sinking, amounted to 15,429 ft.; and although most of the work was done on the main vein more attention was given to lateral veins than in former years. Positive ore reserves at the end of the year were estimated at 307,400 tons, with an average gold content of 0.7 oz. per ton, as compared with 292,000 tons of 0.82 oz. ore a year ago.

The passing of the Bralorne dividend for the current quarter has been explained by the directors as the outcome of a reduction in earnings caused mainly by the labor strike and by the exceptionally low

grade of ore mined of late on the eleventh level. Cash is to be conserved for the purpose of putting into effect a comprehensive program of deep lateral development. Total output of gold for May was 1,614 oz. from 6,194 tons of ore milled, as compared with the April production of 3,850 oz. from 11,876 tons treated. Meanwhile, at the Bradian, adjoining Bralorne, and subsidiary to it, development of the Ida May vein has been particularly successful, opening an orebody carrying about 0.50 oz. gold across 3½ ft. for a length of over 600 ft. to date. At the Wayside, attention is being directed mainly to channel sampling of recently discovered shoots of high-grade ore and construction of the 100-ton cyanide plant. The Minto, which was not affected by the strike because most of the crew hold shares in the company, produced during May 460 oz. gold and 1,926 oz. silver. Mill heads are averaging 0.28 oz. gold to the ton and tests are being made of the use of secondary tables and flotation on table tailings.

The cancellation of the option held by Consolidated Mining & Smelting on the property of Bridge River Consolidated Mines, Ltd., has been announced.

The Vidette, in the Ashcroft division, produced $17,500 of concentrates during May from 891 tons milled. Development work continued to prove milling widths of ore.

The Hedley camp, in the Similkameen valley, has regained some of its former prominence this season with the resumption of operations at the old Nickel Plate mine, once British Columbia's largest gold producer.

Philippine Gold Production Increases

Twelve Gold-Mining Companies Report Gold-Silver Bullion Produced During April to Be Valued 2,518,277 Pesos

GOLD PRODUCTION in the Philippines for the first four months of this year amounts to more than 9,500,000 pesos ($4,750,000). If the average monthly increase is maintained for the remainder of the year, it is likely that the total production will exceed the estimate of 30,000,000 pesos for 1935. Many of the companies are adding to their milling equipment, thereby steadily increasing daily production. The rainfall to date, in the Baguio district, has not hindered mining or milling operations.

The three producers under Benguet management account for nearly two-thirds of the entire Philippine production. Balatoc alone ships approximately half of the bullion from the islands. In April, Balatoc passed the million peso mark for the third time, with a record of 1,068,136 pesos. Balatoc mills an average of 1,200 tons of ore per day.

Benguet Consolidated is the oldest mine in the district and the second largest producer, treating an average of 750 tons of ore daily.

Antamok Goldfields has stepped up its production from 110,000 pesos last October to 225,290 pesos in April. It is now milling an average of 365 tons a day.

Itogen is steadily increasing its mill capacity and now handles around 10,000 tons a month. A new coarse crushing plant installed in May has increased plant efficiency.

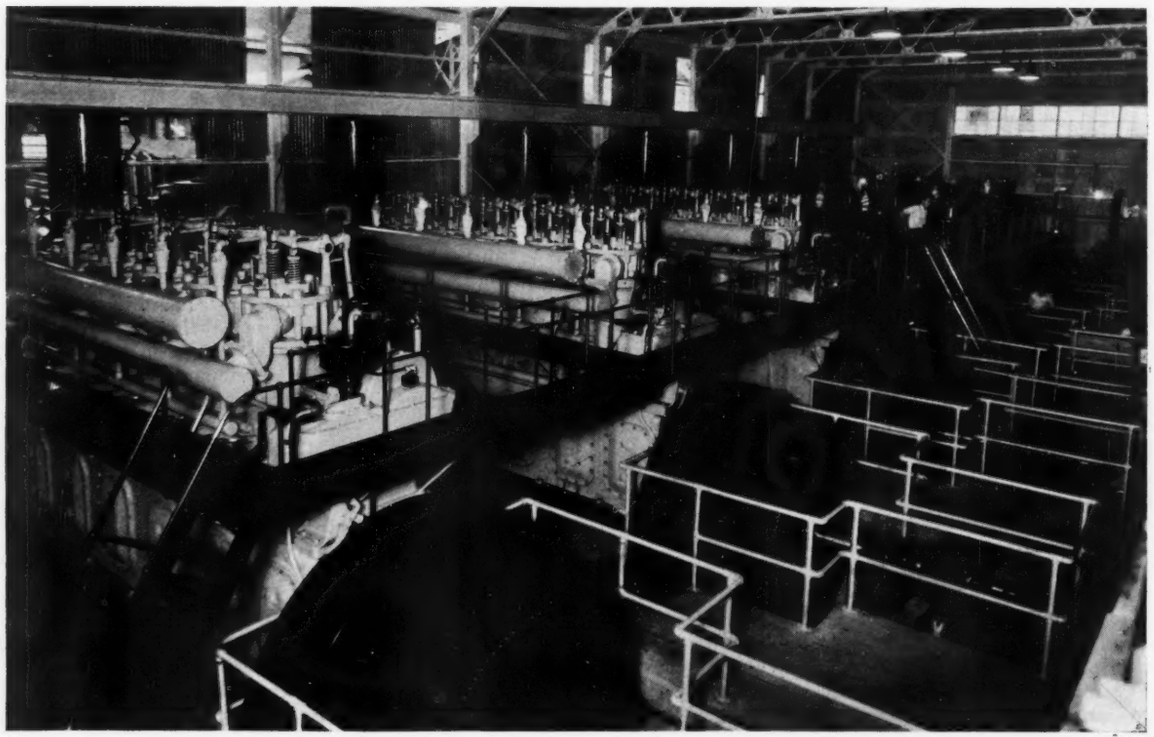
Demonstration, which started milling operations late in 1934, has become one of the outstanding properties in the district. During January it produced 51,000 pesos of bullion, and its future production will be approximately 100,000 pesos per month. Ore reserves have been doubled and mill capacity has been increased to 150 tons a day.

Baguio Gold is increasing its mill capacity and mine facilities by an addition of a new power unit, a new compressor, and mill machinery. Production has fallen off during the construction period, but an average of 75,000 pesos a month has, despite the conditions noted, been maintained.

Suyoc Consolidated, north of Baguio, increased production during April by using some of its stock concentrates and cleaning out the pipe line. The ore treatment at Suyoc, complicated by the presence of nearly 1 per cent of copper, has apparently been solved. Concentrates and bullion are shipped to California for smelting and refining.

Ipo Gold is gradually lowering its production, due to depletion of its ore

World's largest installation of diesel engines used for mining operations at the Balatoc Mining Company, near Baguio, Philippine Islands. There are six 625-hp. diesels totaling 3,750 hp. and 2,500 kw. The increased plant facilities noted increased gold production at the Balatoc Mines



reserves. The smaller producers are steadily operating.

Benguet Exploration averages about 35,000 pesos per month. Paniqui, in the central island of Masbate, ships about 50,000 pesos of bullion monthly, and I. X. L., also in Masbate, about 35,000 pesos.

Tinago and Luya Mining companies, in Masbate, are producing from the operation of small mills.

Gold River Mining Company, at the head of Antamok Creek, Near Baguio, shut down operations after producing 30,000 pesos of bullion in April. A complete new staff is directing mine development and exploration of the company's claims.

Gold Mine Development in Fiji Islands Continues

Australian Correspondent

FIFTEEN companies are now operating on the Tavua gold field in the Fiji Island. It is doubtful, however, if many will obtain satisfactory results. The Emperor lode, driven on for 800 ft. having widths up to 60 ft. with an average assay of 15 dwt., is the most important. Only oxidized ore has been proved to date. On the Loloma lease a lode rich in the telluride nagyagite is being developed by an adit driven from near the bed of a creek. Very rich assays are reported. Indications at present, lend the belief that it may become a large producer.

Dredging interests including Anglo-Oriental Mining Corporation, Ltd., Placer Development, Ltd., and Oroville Dredging, Ltd., are preparing plans for deep dredging at Avoca, Vic. Boring by syndicates has proved large quantities of highly payable wash, and if these results are confirmed, the proposal is to install several all-electric dredges capable of digging 300,000 cu.yd. monthly from 130 ft. A company to carry out the boring is to be formed with a capital of £100,000.

The Commonwealth Government, in association with governments of Western Australia and Queensland, has embarked upon a three years' aërial photographic, geological, and geophysical examination of selected areas in Northern Australia. Areas to be examined total over 3,000 square miles and are known to be metalliferous. The aërial photographs will be taken by the defence planes of the Royal Australian Air Force, flying at a height of 10,000 ft. The size of the individual photographs will be 8¾ in. by 6½ in. and 200 exposures will be recorded on each film. The photographs will be pieced together to form a mosaic map of the area and the results of field examination of variations in rock structure will be recorded on the map. An outline geological map will result. Costeaning, drilling, and geophysical surveys will be carried out on promising indications.

Government Poll Tax in Northern Rhodesia Is Cause of Native Strike

Natives in African Copper Belt Object to Imposed Tax Made by Rhodesian Government and Register Objections by Striking in the Copper Mines

London Correspondent

A STRIKE by native employees occurred at the Mufulira Mine, in Northern Rhodesia, late in May. It was followed a few days later by a similar strike at the Rhokana Corporation's N'Kana mine and smelter, and still later by a strike at the Roan Antelope Mine. There was an attempt at rioting at Roan, and in conflict with the police six natives were killed.

The immediate cause of the strikes was that the Northern Rhodesia Government raised the poll tax of the natives employed in the copper belt to 15 shillings a year, leaving the rate at 10 shillings throughout the rest of the Colony. There were no differences between the natives and the mining companies. The Europeans employed were able to keep the mine and mill running at approximately the normal rate during the three or four days that the strike lasted. At Roan Antelope the strike started May 29, and a full force of natives was at work again June 1.

Acting on the theory that the strikes were due to the activities of a native secret society, the government of Northern Rhodesia (Sir Philip Cunliffe-Lister stated in the British House of Commons) proposes to appoint a commission to inquire into the cause of the disturbances. The government has stated that there is no actual dispute to settle. Working conditions at the mines are now normal.

A 6-yd. steam shovel which replaced tedious hand labor in a Nigeria tin mine

Adjustment of the Southern Rhodesia gold premium tax, the Minister of Mines says, is intended to encourage the reopening and working of low-grade mines. A flat tax of 15 per cent was levied under the former law on all mines producing over 300 oz. annually. It was discovered that the output of some mines was intentionally being kept below this limit, to escape the tax. The new law is that those milling ore of less than 2½ dwt. per ton shall be exempt; those milling 2½- to 3½-dwt. ore pay a tax of 7½ per cent, and higher grade will pay 15 per cent. It is not surprising that the government "hasn't the heart" to tax anyone producing from less than 2½-dwt. ore.

Southern Rhodesia's gold output is beginning to show a gratifying increase. It was up to 58,521 oz. in April, this comparing with 57,360 oz. a year ago. Quite a little new production will come in between now and the end of this year. Bushtick Mines, Ltd., expects to have its new mill in operation in September. This company, formed by Sir Edmund Davis interests, is developing what promises to be a very large tonnage of 3- to 4-dwt. ore. In this case an old mine of good reputation is being brought back, after eighteen or twenty years of inactivity, by the higher price of gold.

Returns so far received show that nearly all mines of the Rand are increasing their outputs of ore and tonnages milled, but that their production in ounces of gold remains about the same. The reduction of costs has not yet gone as far as one would expect in view of the greater amounts of low-grade ore mined and treated. Despite the appreciably larger tonnage milled, May profits with gold taken at 142s. per ounce will be only about the same as in April, when they were figured on an average price of 143s. per ounce. April's output was 865,755 oz., valued at £6,190,000.

Development of new properties and increases of milling capacities are continuing on the Rand, but it is apparent that expansion would be much more rapid if it were not that taxation of mining profits is considered excessive and

that there is lack of assurance or any knowledge as to what the government's future tax policy will be. Estimates are given out that as high as 75 per cent of all this year's gold-premium excess profits will be taken from some of the companies by the government, but 50 per cent will probably be more nearly the correct proportion. The premium has nevertheless enabled them to increase their dividends considerably.

Loangwa Concession's report describes the gold discoveries in its Liteta and Chitete areas, about which several exciting rumors have been afloat, as "promising," adding that "no opinion can be formed as to the value of these occurrences until considerably more work, including systematic sampling, has been done upon them." These developments will be watched with interest by many, due to the fact that very little is so far known concerning the gold deposits in Northern Rhodesia.

In Tanganyika Territory the gold shoots in the property of East African Goldfields are being tested at depth with the diamond drill. The deepest hole drilled has cut 18.9-dwt. ore, 17 in. wide, at a depth of 530 ft. Another boring found similar value over 46 in. at 360-ft. depth. These developments will give new courage to the many who are at work on gold occurrences in Tanganyika Territory and Kenya Colony, which show much better than workable values at shallow depths.

Preliminary figures given out by Union Minière du Haut-Katanga show that the 1934 profit was, in terms of United States currency, over $5,115,000, despite a lower price having been received for copper than in the preceding year. After meeting all interest and other fixed charges, the company will have left upward of $3,266,000, which will be applied to a further writing down of the metals it has on hand. It is understood the report will say that the company has been placed in a much better position by the devaluation of the Belgian franc, and that the prospect now is that dividend payments will be resumed next year.

Rhodesia Broken Hill Development Company's May output was 1,645 tons of electrolytic zinc and 120 tons of vanadium concentrates.

Indian Copper Corporation, which is benefited by India's heavy import tax on copper, made sufficient profit last year to pay a small initial dividend on its ordinary shares. Its production was 6,300 long tons of refined copper, against 4,800 tons the year before, this being manufactured into yellow metal, sheets, and circles and sold locally.

Trepca Mines, Ltd., produced 5,571 metric tons of 79.87 per cent lead concentrates containing 24.7 oz. of silver per ton, and 7,446 metric tons of 49.9 per cent zinc concentrates, in May from the treatment of 49,567 metric tons of ore. This company has just declared an interim dividend of 3d. per share.

Higher Silver Price in Mexico Promotes Strikes

Miners in States of Guanajuato and Michoacan Seek Aid of President Cardenas to Increase Wages—Mazapil Copper Settles Its Strike by Granting Concessions to Employees—Ministry of National Economy Sponsors Financing Program for Mining Industry—States to Share Federal Tax Income on Silver Production

THE MINING INDUSTRY in Mexico today is afflicted with strikes and their resultant conciliatory adjustments between miners and operators. Exploration and development of silver-gold mines continue. New mine financing sponsored by the Ministry of National Economy and other interests are high lights.

Mexico experienced 1,200 strikes that affected various industries, including mining, from January to June, 1935, according to the federal Board of Conciliation and Arbitration. This is claimed to be a world's record for strikes in a six months' period. Though a great number of these strikes were settled, many are still in progress.

Union miners of Guanajuato have asked President Cardenas to support their demands for higher pay. They assert this is justified in view of the prosperity of the silver market. These unions have a membership of approximately 4,000. The petition to the President hints that preparations for a strike will be made if the mining companies are not induced to increase wages.

Resumption of work in mines of Mazapil Copper in the Conception del Oro sector, Zacatecas, as a result of the settlement of a three-month strike, was a feature of the start of summer in the Mexican mining industry. The strike involved about 1,500 employees. Annual vacations with pay, free medical treatment and medicines, and 50 per cent of wages for 45 days for sick employees were some of the concessions the company made.

Governments of states in which silver is produced are allowed shares of from 2 to 5 per cent in the federal tax on the white metal, under a decree recently issued by President Cardenas. The amount of the share depends upon the price of silver. Metal and mineral producing states are also allowed shares of federal imposts, ranging from 2 per cent for gold to 0.025 per cent for coal.

The Cia Minera de San Jose de Pachuea, at its Zemapan unit, Hidalgo, is doing considerable work in preparing new mines for operation.

President Cardenas has ordered rich iron and coal lands in the states of Puebla and Oaxaca to be incorporated into the federal mineral reserve. The Cia. Minera de Chontalpa, S. A., has settled a dispute with its employees of the Zitinga mine, Guerrero, by granting increased wages and a weekly holiday with pay.

Employees of the Tlapujahua unit, Michoacan, are demanding the Cia. Minera dos Estrellas to increase wages and sign a collective labor contract. A strike is threatened if the company does not grant the demands.

El Tambor, site of rich gold placer deposits, in Sinaloa, is to be connected with the west coast port of Mazatlan by a road suitable for motor vehicles. State and municipal authorities are constructing a spur road from El Tambor to Campanillas, where it will connect with the highway to Mazatlan. The spur will be completed soon. The present road from El Tambor is open only to horse and mule transportation; therefore, road building will help considerably in the development of this gold area.

A broad financing program in the mining industry is being developed by mining men and the recently organized Banco Minero y Mercantil, S. A., of Mexico City. The program calls for the establishment of branches in several mining zones. It is understood that the first of these will be opened in Durango City. The plan is being sponsored by the Ministry of National Economy.

The Mexican Chamber of Commerce of the United States, Inc., with office in New York City, has advised the Ministry of National Economy that important American interests desire to acquire silver-gold properties in Mexico. The ministry also reports that California interests with headquarters in Los Angeles wish to acquire asbestos properties in Mexico.

During May, the San Francisco Mines of Mexico treated 34,890 metric tons of sulphides and 7,070 metric tons of oxides. Lead concentrates produced 4,988 metric tons. Zinc concentrates produced 2,629 metric tons.

Australian Gold Strike

A sensational development has been reported from the Yellowdine property, in Western Australia. It is that a crosscut just completed at one point shows a total width of 30 ft. of quartz with an average assay value of over 3 oz. of gold. Another crosscut has revealed 50 ft. averaging 10 dwt. The remarkable formation being developed varies considerably, it would appear, in both widths and values; but for so large a deposit the gold content averages astonishingly high.

PERSONAL ITEMS

Norman Bretz has been in Nevada inspecting mine properties in which he is interested.

C. O. Stee, manager Siscoe Gold Mines, Ltd., Quebec, Canada, was in New York City in July.

W. H. Gould, of San Francisco, has been inspecting quicksilver properties in southern and central Nevada.

J. W. Hamilton is in charge of McIntyre's Mud Lake property in the new field, 65 miles south of Rouyn, Que.

T. C. Dénis, of the Quebec Bureau of Mines, has been honored by Laval University, Quebec, with an LL.D.

Irving A. Palmer, professor of metallurgy, Colorado School of Mines, returned to Golden on July 7 after a visit to New York.

Fred W. Kuenzel has been appointed mine superintendent for Bunker Hill Arizona Mining at Sombrero Butte, Ariz.

H. C. Carlisle, with offices in San Francisco, lately made a brief examination of the Como Mines property for Eastern clients.

Alex G. Hattie is manager of the Pickle-Crow mine, in the district of Patricia, Ontario, whose 100-ton mill is treating one-ounce gold ore.

L. J. Harvey is now mill superintendent for the IXL Mines, in Masbate, P. I. He was formerly at Balatoc and at the Antamok Goldfields Mining Company.

L. C. Stuckey, consulting engineer of Gold Corporation, Ltd., London, is visiting Australia. His company is carrying out development work at Bendigo.

Ray J. Barber, mining engineer, is in Bogota, Colombia, investigating gold properties held under option by San Francisco and New York interests.

H. T. Curtis has arrived in the Philippines from Vancouver, and is now general superintendent of the Paracale Gold Mining Company in Camarines Norte.

Jesse L. Maury has been appointed associate mine valuation engineer for the Securities and Exchange Commission, with headquarters in Washington, D. C.

R. L. Mundell has resigned his position with the Rocky Mountain Gold Mines Company, Nederland, Colo., and has sailed for the Philippines to work at the Balatoc mine.

P. M. Cropper, editor-publisher of the *Mining and Industrial News,* of San Francisco, was a recent visitor to the Comstock district and other Nevada mining centers.

N. S. Morrison has been appointed to the staff of Gold Coast Selection Trust and sailed recently from Halifax, N. S., to take up his duties in the colony as field geologist.

Harry O. King, formerly managing director of the Copper Code, has opened offices in the Chrysler Building, New York, to engage in the business of selling copper, lead, and zinc.

Charles Cushing has been transferred from the Paracale-Mambulao operations of the Marsman interests to Baguio, P. I., where he is supervising Empire drilling in the Bued River.

Dr. H. E. McKinstry, consulting mining geologist for Case Pomeroy & Company, New York, left on return to U. S. A. at the end of April after a two years' stay in Australia.

V. L. McCutcheon, superintendent of the Morococha mines of the Cerro de Pasco Copper Corporation, Morococha, Peru, S. A., is in the United States for a three months' vacation.

J. C. R. MacPherson, who has been appointed manager of Sullivan Consolidated Gold Mines, in Quebec, was in charge of the property during the early stages of its development.

Thomas G. Moore has entered the employ of The American Metal Company, Ltd., as a field engineer and will be engaged in work in the Western part of the United States.

J. G. Cross is developing the Cameron Island mine, in the Lake of the Woods area, Ontario, which promises to be the first of a number of gold mines to be re-established in this district.

Lou M. Louis, construction engineer who lately completed a 50-ton flotation mill for Rochester Plymouth Mines, in Pershing County, Nev., is making his headquarters at Lovelock, Nev.

J. Gordon Hardy, vice-president of Falconbridge Nickel Mines, Ltd., is visiting the company's refinery in Norway. Mr. Hardy will be back in New York in the early part of July.

J. H. Marsman, president of Marsman & Company and president of the Gold Mining Association of the Philippines, returned to the Islands the latter part of May after an extended visit in London.

L. D. Gordon, for a number of years president and manager of Nevada Porphyry Gold, operating the Round Mountain mines, has resigned in order to devote his time to personal interests.

Dwight L. Sawyer has resigned as manager of the Quarette Mine, Searchlight, Nev., and is now chief engineer for Golden Queen Mining Company at the Silver Queen Mine, Mohave, Calif.

Angus Campbell, formerly of the McIntyre-Porcupine staff, has been appointed manager of Omega Mines, which has been incorporated to operate the Crown Reserve property at Larder Lake, Ont.

William Otis Hotchkiss, President of the Michigan College of Mining and Technology, has been elected President of Rensselaer Polytechnic Institute, Troy, N. Y. to succeed the late Palmer C. Ricketts.

S. W. Norton, of the Itogon Mining Company staff, has been transferred to the United Paracale Mining Company in Camarines Norte, P. I., where he will supervise the construction of the new 125-ton flotation plant.

Adam A. Boyd relinquished the position of general manager of Mount Morgan, Ltd., Queensland, at the end of June. He will be succeeded by **A. F. McAskill,** at present assistant general manager of Mount Isa Mines, Ltd.

Jacob Stroup is in charge of the construction of the new 200-ton mill for the Salacot Mining Company in Bulacan, P. I. He arrived in Manila early in the year after a varied experience in mining and milling in Mexico and the United States.

A. J. Klamt, recently of Arizona, has been appointed consulting engineer of the Blank interests, including the Blank Lease and the Piute Mining Company and others located on the new discovery at the Middle Butte, adjoining the Trent interests in California.

H. Foster Bain, former secretary of the A.I.M.E., spent several weeks in the Philippines recently, inspecting gold mining operations in the Baguio and Paracale districts. He also visited the chromite deposits being developed by Benguet Consolidated at Zambales.

L. J. Hull, South Dakota State School of Mines, 1935, was the recipient this year of the prize of $100 awarded annually to the student enrolled in metallurgy who gives promise of high accomplishment. The award was established in 1927 by J. V. N. Dorr.

Dean W. R. Appleby of the School of Mines and Metallurgy of the University of Minnesota, is retiring after 44 years of service. A farewell banquet honoring him was held at the Curtis Hotel at Minneapolis attended by approximately 300 of his former students. **Prof. Peter Christianson,** also retiring after 30 years as professor of ferrous metallurgy at the University, was also honored at the same banquet.

Leslie Bradford, well known as the original discoverer of the use of copper sulphate in activating zinc blende, has been promoted to the position of general manager of the Broken Hill Proprietary, Ltd. He was previously manager of the Newcastle steel works of the company.

Guy C. Riddell left New York on June 22 to spend several months in Europe on professional work which will take him to England, Germany, and Rumania. He will be in Moscow during August, his headquarters being the American Chamber of Commerce.

Duncan Smith, formerly of Bruxelles, and **W. A. Baeuris,** of Seattle, have formed a partnership as Baeuris & Smith, consulting engineers, with offices in Seattle, Wash., and Vancouver, B. C. Both members of the firm are engaged at present in examining gold prospects in the far northwest.

Churchill G. Scott, formerly of the Gold River staff, is now a member of the consulting staff of Marsman & Company, Manila, P. I., as a junior mining engineer. At present he is engaged in prospecting and exploring a group of chromite claims in Zambales on which Marsman & Company have options.

Henry P. Ehrlinger resigned from his position as superintendent of the Portable Power Tool Corporation, in Warsaw, Ind., and has accepted a position as assistant manager of the New Mexico division of the Peru Mining Company, a subsidiary of the Illinois Zinc Company, at Deming, N. M.

E. W. Bedford, formerly consulting engineer for the International Rustless Iron Corporation of London, arrived in the Philippines recently from California, to join the staff of Marsman & Company, Inc., as superintendent of the North Mindanao venture. Bedford has had a wide experience in mining in the United States, British Columbia, and Alaska.

Herman J. Rossi, Wallace, Idaho, has been named chairman of the board of directors of the American Grubstake Syndicate, an organization created to assist in the development of promising properties through the grubstake method. One property is now under operation in the Murray district under the grubstake plan and others are now under consideration.

Judge John W. Haussermann, president and general manager of Benguet Consolidated, is now in the United States for the purpose of conducting a survey of the chromite market. The two major chromite properties in the Philippine Islands, at Florannie and at Masinloc, are being operated by Benguet, and active production will depend upon the result of Judge Haussermann's findings.

Robert C. Stanley, President of the International Nickel Company of Canada, Ltd., was awarded the honorary degree of Doctor of Engineers by Stevens Institute of Technology at its sixty-third commencement exercises June 8. Mr. Stanley is an alumnus, having been graduated in 1899 with the degree of mechanical engineer. On Dec. 14, 1933, he was elected to serve as a member of the board of trustees.

R. C. Meaders, formerly metallurgist with the Tennessee Copper Corporation, Copper Hill, Tenn., has become a member of the staff of the Benguet Consolidated Mining Company, Philippine Islands, and is now stationed in Mindanao, where he is to do geological and mining engineering consulting work. He was on the Balatoc mill staff in Baguio for a short time before leaving for the Southern Islands.

OBITUARY

W. J. Truscott, mine inspector of Itasca County, Minn., for many years, and a pioneer of the Missabe range, died suddenly on May 4 at Coleraine, Minn.

Charles Renwick, mining engineer of Richmond, Calif., died on June 15 while climbing the great pyramid at Cholula, Puebla State. Mr. Renwick was about 60 years old.

John B. Adams, 82, died June 7 at Carmel, Calif. Before retiring, ten years ago, he was active with R. M. Bennett, of the firm of Longyear & Bennett, on the various Lake Superior iron ranges.

W. J. Young, Jr., died in Tucson, Ariz., on May 31. With his two brothers, Courtland H. and Edward Young, he obtained extensive mining properties just east of Tombstone, where a flourishing settlement, known as Courtland, grew during the boom days of the copper industry.

Alfred White, for the past ten years secretary to Charles Bocking, president of Granby Consolidated Mining, Smelting & Power Company, died suddenly in Vancouver on June 13. A former resident of Salt Lake City, Mr. White has lived for many years at Vancouver. He was 46 years of age.

Harry S. Knight, Salt Lake City mining man and assistant superintendent of water works for the city, dropped dead May 27 just as he entered his office. Born May 9, 1873, at Ilion, N. Y., Mr. Knight had been head chemist for the Hanauer Smelting Company, at Bingham; chief chemist at the Highland Boy mine; and for many years a member of the Knight & Warnock Company, ore purchasers. For a number of years he was active in mining at Arco, Idaho.

Lester Wallack Strauss

Lester Wallack Strauss, American mining engineer, who had since 1906 specialized in the development of mining properties in South America and Central America, was killed in an airplane accident at Medellin, Colombia, on June 24, while on a professional assignment trip. Mr. Strauss was born in New York City in 1879. He was graduated from Columbia School of Mines in 1900, and immediately thereafter accepted employment as an assayer with Consolidated Dahlonega Gold Mines, in Georgia, and later with the Emma Mining Company, in Sonora, Mexico. In 1901 he was appointed chemist for Old Dominion Mining & Smelting, at Globe, Ariz., following which he become assayer and engineer for Federal Lead, at Flat River, Mo. In 1906 he was appointed examining engineer for Peruvian Mining, Smelting & Refining, at Lima, Peru, where he married Miss Bertha Miller, of Plattsburgh, N. Y., who, with their three children—all born in South America—survives him. His son, Simon D. Strauss, was a member of the editorial staff of *E.&M.J.* from Nov. 15, 1927, to April 1, 1932. Lester Strauss was a frequent contributor to the columns of *E.&M.J.* over a long period of years. He was as popular with the men of the mining industries of Central America and South America as with hundreds of his contemporaries of the A.I.M.E. and numerous executives of mining companies, to whom his passing will bring, with its sorrow, appreciation of the privilege of a warm and long friendship.

Andres Flores, widely known mining man of the Suaqui Grande district, Sonora State, Mexico, died recently of injuries he suffered in a fall down a shaft of one of his mines in that zone. Flores began his mining career as a prospector and later became a mine owner. He was about 56 years old.

Bertram Harvey Dunshee, 78, well-known Butte mining engineer, born at Bristol, Vermont, died at his home in Berkeley, Calif., on May 27. He was a graduate of the University of California, and later became superintendent of the Granite-Bimetallic operations in Philipsburg, Mont. In 1897 he moved to Butte, where he was superintendent of the Boston & Montana Company. When this company consolidated with Anaconda Copper Mining Company he became assistant general superintendent.

Richard A. Parker, mining engineer, died at his home in Denver, June 9, at the age of 79. He was born in Ireland of English parents, who brought him to the United States as a child of six. After an early engagement as a draftsman for the Northern Pacific Railroad he entered Columbia University School of Mines, from which he was graduated in 1878. His mining career was marked by management of iron mines in Michigan and of the Simmer and Jack gold mine of South Africa. During the latter engagement he participated actively in the Jameson raid and was a witness in the famous trial when John Hays Hammond and other leaders of the revolt were sentenced to death, but later released. On his return to the United States he was consulting engineer and vice-president of United States Smelting, Refining & Mining Company, and president of the American Zinc, Lead & Smelting Company. He was a member of the A.I.M.E., and of the Legion of Honor of that organization; the Mining and Metallurgical Society of America and the Colorado Scientific Society. He was a talented artist in water color and president of the Business Men's Art Club of Denver. From Columbia University he received degrees of C.E. in 1878 and E.M. in 1896. The Colorado School of Mines conferred on him the honorary degree of Sc.D. in 1930, and in 1933 he was awarded honors from Columbia University for conspicuous service as an alumnus. He is survived by his wife and two sons, Everett H. Parker, a Denver mining engineer, and Richard B. Parker, of Cleveland.

Hubert Phelps Whitmarsh, 71, first governor of Benguet, Mountain Province, P. I., and original locator of four outstanding gold mines in the Baguio district, died April 16 in Baguio after an illness of five months. Mr. Whitmarsh was born in Quebec and had a varied career all over the world as a journalist, business man, and miner. He covered

Hubert Phelps Whitmarsh

the Spanish-American War in Cuba and the Philippines for *Outlook, Atlantic, Century,* and *Scribners.* He was the author of several books for boys written about his own experiences.

He was in the Mount Morgan gold rush in Australia, and later discovered a silver mine in that country. His mining activities in the Islands started soon after the end of the Spanish-American War. Hearing of priests who were purchasing gold from the mountain natives, he journeyed to Baguio by foot and horseback. His prospecting activities established the existence of ore-bodies near Baguio, and he was active in the subsequent development of the mining industry in that district. He became first governor of Benguet because of his insight and understanding of the Igorot peoples and of their problems.

Mr. Whitmarsh purchased land from the Igorots and at one time owned practically all of the city of Baguio. He started the first sawmills and lime kilns, and opened the first large general store. He grubstaked many prospectors and was the original locator of the Headwaters Mine, now Baguio Gold; the old Sangilio property, now the Itogon Mining Company; the Magma, in conjunction with J. D. Highsmith, which is now Benguet Exploration; and the Copper King, which is now Demonstration Mines, Ltd. At the time of his death he was a large stockholder in most of the major mines in Baguio and a director in many of them.

D. A. Miller, formerly master mechanic for the American Smelting & Refining Company in Mexico, and for the last four years mechanical superintendent at the Patiño properties in Bolivia, died on May 18 at Llallagua, Bolivia.

Justus Jungk, 77, retired Utah mining man, died June 7 at Salt Lake City. Mr. Jungk was born in Cassel, Germany, in 1857, and came to Salt Lake in 1875. For many years he engaged in mining and smelting work.

George Cushing, one of the most prominent mining engineers in the Philippine Islands, died in Manila April 1, of septicemia. He was rushed from Paracale by airplane in February to undergo an appendicitis operation, and had been under a doctor's care since that time for malignant malaria. Mr. Cushing, a native of New Mexico, came to the Islands in 1926 for the Syndicate Mining Company at Aroroy, Masbate. He went to the States later, returning to the Philippines in 1933. After working in the Baguio district for some time, he returned to Paracale to do exploration and prospecting work on his own. He discovered and developed many mining properties, and was among the leaders in his profession.

William J. Pike, 53, mining engineer for Equitable Exploration Company, committed suicide April 21 in Manila by taking poison. Ill health was given as the reason for his act. Mr. Pike was a native of Winnemucca, Nev., and worked for several mining companies in the States before coming to the Islands in 1930.

William A. Smith, 23, recent graduate of the University of California in mining engineering, died in Baguio April 10, after a sudden attack of double pneumonia. He came to the Islands in 1934 to take charge of mine development work at Antamok Goldfields.

Edward Salisbury Dana, eminent geologist and mineralogist, died at his home in New Haven, Conn., June 17, 1935, at the age of 85. He was a member of the faculty of Yale University for 43 years, and chairman of the board of trustees of the Peabody Museum for 30 years. He succeeded Benjamin Silliman as editor of the *American Journal of Science.* To the mining industry Professor Dana was probably best known for his sixth edition and appendix of Dana's System of Mineralogy, inaugurated by his father, James Dwight Dana. Many honors came to Professor Dana in the course of his long career, recognized by the Yale Corporation in its resolution that "he brought to himself and to the University widespread recognition in the world of science."

LETTERS

A Traveling School of Mines

The Editor:

To help prospectors and parties interested in minerals and prospects, the State of Nevada, acting under the provisions of the Smith-Hughes Act, has organized a traveling school of mines to give a free three-week course at mining camps and towns where attendance and interest justified.

D. C. Cameron, State superintendent of vocational education, opened the first school at Ely in 1934, and the success obtained aroused the interest of other camps, and the traveling school became necessary.

Starting in October last, sessions were held at Elko, Fallon, Hawthorne, Yerrington, Las Vegas, Boulder City, Panaca, Pioche, Battle Mountain and Caliente. A five-week course was held at the C.C.C. relief camp of Kingston.

The popularity of this prospector's course called for a duplicate traveling school, with F. G. Gibson and T. D. Overton instructors, and sessions were or are to be held at Virginia City, Sparks, Wells, Elko, Goldfield, Manhattan, Round Mountain, Ely, and Ruth.

The condensed but practical course consists of lectures and charts on geology, vein formation, ore occurrences, mining law, and practical blowpipe determinations. The Federal Government pays one-half, the State of Nevada furnishes transportation and one-fourth of the instruction expenses, the local district furnishes the school quarters and one-fourth of the instructors' salary.

These courses have awakened an interest in mining instruction of adopted standards and a renewed interest in prospecting which may by this self-help instruction prove more beneficial to the mining industry in Nevada than any other federal relief agency.

Goldfield, Nev. CHARLES LABBE.

Ore-Dressing Research At Kalgoorlie

The Editor:

I notice on page 99 of your issue for February, 1935, a statement that the Commonwealth Government, by a special grant, has made possible the establishment of an ore-dressing research laboratory at the Kalgoorlie School of Mines. Permit me to state that this laboratory was established by the Mines Department of Western Australia in 1923 and has since that date, at the request of operating companies, conducted valuable and important investigations into the treatment of ores and metallurgical products, not only from Western Australia but also from other states of the Commonwealth, as well as from outside Australia. Among these may be mentioned the initial original research into the flotation of Kalgoorlie and Wiluna gold ores, which ultimately led to the erection of flotation plants to treat the ores at both places. Most of the reports on these investigations have been published in the form of bulletins.

The Commonwealth grant, which has been made available through the Commonwealth Council for Scientific and Industrial Research, is £1,000 per annum for a period of five years for each laboratory mentioned and has been made for the purpose of extending the work of the Kalgoorlie laboratory and of equipping the other two laboratories. The work of the Kalgoorlie laboratory is well known throughout Australia and also in America, South Africa, and England. I trust, therefore, that you will correct the statement appearing in this issue.

B. H. MOORE,
Principal, School of Mines, and
Officer in Charge, Metallurgical Laboratory.

Kalgoorlie, Western Australia

NEW BOOKS

Cupellation and Silver Loss

THE INFLUENCE OF CUPELS ON SILVER LOSS. *By T. T. King, Associate Professor of Mining Engineering, University of Toronto, Bulletin No. 147. Pp. 69.*

The increased value of gold and silver adds to the responsibility of the assayer in reporting gold and silver content of an ore accurately. Some assayers obtain high results; others low. Why? The usual answer is that each has his personal equation. That, however, is not the answer given by the author's thorough research into cupels and silver loss. The cupellation process of silver assaying, generally understood for centuries, reveals, after intense study and research, conclusions which are fundamentally sound and have practical broad application by the assayer of today.

Professor King has subjected the various sizes and shapes of cupels, made of varying proportions of bone ash, clay, and cement, to numerous tests in connection with silver assaying. These tests were made under numerous complex conditions. The research, therefore, takes into consideration the variables entering into cupellation.

Several years were required in this research, which netted twelve conclusions:

1. In making composite cupels using variable percentages of bone ash and cement, all cement losses were over 0.05 per cent above those of all bone ash. With mixtures of 20 to 80 and 40 to 60 bone ash-cement the average losses were practically the same as with all bone ash. Feathers were obtained on all cupels except those of all cement. Therefore, composite cupels of 70 per cent cement and 30 per cent bone ash by weight (not by volume) gave as low a loss as those of all bone ash. Their cost is one-third as much. Moistures should not exceed 10 per cent; from 6 to 8 per cent is satisfactory with a pressure of 800 lb. per square inch at the die.

2. To obtain cupels of the same height, the amount of ash, water, and pressure must be kept constant. For uniform losses, cupels should be of equal height. With cupels varied in height from $1\frac{1}{8}$ in. to $\frac{1}{2}$ in., the loss increased with decrease in height.

3. Cupels made with a gradation in sizes of bone-ash particles are superior to those where any one size of particle predominates. A mixture which gives a maximum density is indicated as desirable.

4. In graded bone ash of good quality where sizes coarser than 35 mesh are absent, considerable latitude in the percentage of each size present is permissible without affecting a detectable amount of loss in routine work.

5. The high-pressure cupels gave lower loss than those of lower pressure, but would not operate at as low a muffle temperature. Time of cupellation did not increase with density. Pressures of from 800 to 1,600 lb. per square inch at the die, with water 10 to 12 per cent, are recommended for bone ash. Whatever combination is used should be kept constant from cupel to cupel.

6. Volatilization loss is a common alibi, in practice and literature attributed to arratic assaying. Volatilized silver losses were found to be under 0.05 per cent of the total silver loss in cases investigated, or 0.0076 per cent of the total silver present. This conclusion is in harmony with other investigations.

7. The notion still persists that "the older the cupel the better the assay," as it did 400 years ago, when Agricola recorded that conclusion. Careful drying to avoid cracks is the essential requirement in seasoning cupels properly, and any definite period of seasoning or aging bone-ash cupels is unnecessary.

8. With reasonable finishing temperatures (860 to 870 deg. C.) beads may be left in the muffle after finishing without appreciable loss.

9. Within the range of depth ordinarily used, increasing the cupel cup depth while retaining the same general shape decreases the loss but increases cupellation time.

10. The shape of the cup is an important factor affecting both loss and time.

(a) Cup shapes whose chief characteristic is that they raise the cupelling lead into the air stream increase loss and decrease time.

(b) Cup shapes whose chief characteristic is that they lower the cupelling lead from the air stream decrease loss and increase time.

11. An improved form of cup has been developed which, in comparative trials, under various temperature conditions and with varying amounts of lead, gave much lower losses than a standard cupped cupel.

12. In comparative assays, and as a basis of purchase and sale of metal, a standardized cupel should be adopted by all parties concerned.

In the bulletin, these conclusions are fortified by numerous tables, diagrams, and graphs indicating diligent and careful research.

ENGINEERING INDEX, 1934 VOLUME. *Published by Engineering Index, Inc., 29 West 39th St., New York. Pp. 1320. Price $50.*

Descriptions of engineering items printed in 2,000 different publications are given in this volume, and 40,000 separate items of periodical literature are listed under 5,000 subject headings. In all, 25,000 different authors, writing in 40 countries and 20 languages, are cited. The publications covered by the Index fall under three main classes, the largest being made up of periodicals or magazines devoted to engineering, pure science, other technical subjects, and industrial literature. The second class includes the transactions, proceedings, and other publications of every engineering or allied technical society anywhere in the world. The third class includes a wide variety of so-called irregular serial publications, such as government bulletins and bulletins of universities, of engineering experiment stations, research organizations, and industrial companies.

Publications Received

California Mineral Production for 1933 and Directory of Mineral Producers. Bulletin 110, Division of Mines, San Francisco, Calif. Pp. 214.

Geology and Literature. By W. H. Collins. Bulletin of Geological Society of America, New York. Pp. 373.

Origin of the Copper Deposits of the Ducktown Type in the South Appalachian Region. By Clarence S. Ross. U. S. Geological Survey Professional Paper 179. Superintendent of Documents, Washington, D. C. Pp. 165. Price 45c.

Review of Literature on Effects of Breathing Dusts, With Special Reference to Silicosis. Parts I and II. By D. Harrington and S. J. Davenport. Information Circulars 6835 and 6840, U. S. Bureau of Mines, Washington, D. C.

Milling Methods and Costs at the Concentrator of the St. Joseph Lead Co., Atlanta, Idaho. By E. D. Gardner. Information Circular 6836, U. S. Bureau of Mines, Washington, D. C. Pp. 11.

Mica. By F. W. Horton. Information Circular 6822, U. S. Bureau of Mines, Washington, D. C. Pp. 57.

Opportunities for Obtaining Accident Prevention Information. By C. A. Herbert. Information Circular 6838, U. S. Bureau of Mines, Washington, D. C. Pp. 6.

Transactions of the Canadian Institute of Mining and Metallurgy and the Mining Society of Nova Scotia. Vol. XXXVII, 1934. 923 Drummond Bldg., Montreal, Que. Pp. 584.

The Fertilizer Industries. By Paul M. Tyler. Information Circular 6834, U. S. Bureau of Mines, Washington, D. C. Pp. 41.

The Salt Industry of Louisiana and Texas. By W. M. Weigel, T. P. No. 620, A.I.M.E., New York, Pp. 19.

Mining Marble. By George W. Bain. T. P. No. 626, A.I.M.E., New York. Pp. 18.

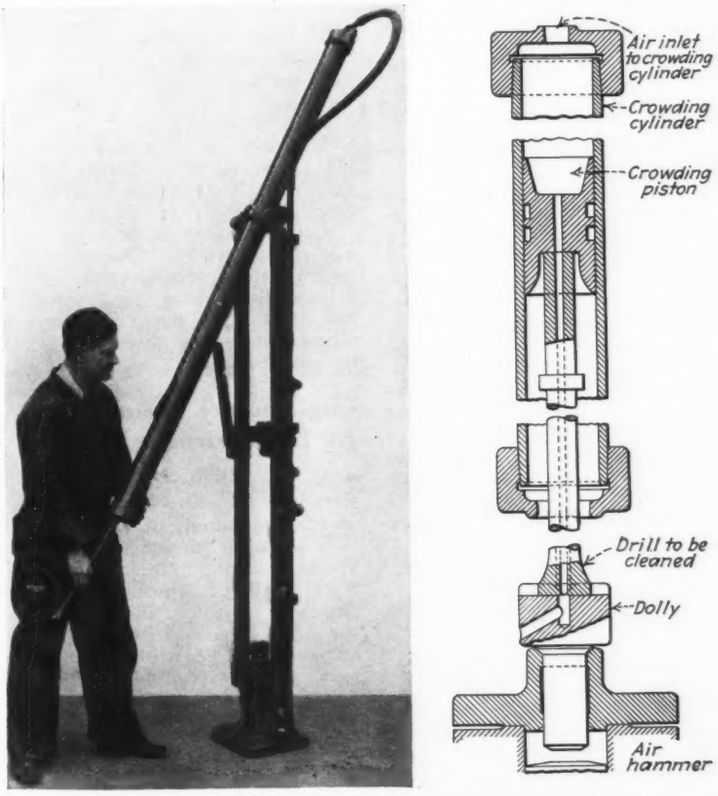
EQUIPMENT NEWS

Plugged Steel Cleaned by New Machine

Hole in Hollow Drills Opened Within a Few Seconds in Sharpening Shop With Aid of This Device—Operation Is Simple

• After experimenting for several months with a machine designed by O. E. Schiffner for cleaning hollow steel drills, the Pan-American Engineering Corporation, Ltd., 820 Parker St., Berkeley, Calif., announces that the machine is now in production at its construction plant.

The first of these machines built by Pan-American was shipped for use at the Lava Cap mine, near Grass Valley, Calif., and the management reports satisfactory performance after six months of continuous use.



To clean a plugged hollow drill steel, it is inserted in this machine and the air is turned on, first to force the steel against the air-hammer dolly (at the bottom) and next to actuate the air hammer. Construction details are shown in the drawing at the right

Operation of the machine is simple. After inserting the plugged steel into the machine, air is turned first into the crowding cylinder, the piston of which in turn forces the drill firmly against the dolly of the air hammer below. Next, the air hammer is actuated by turning on the air, and the rapid and powerful blows delivered against the dolly set up violent, vertical vibrations in the plugged drill. In a surprisingly short time the plug cracks up, and its fragments drop out of the hollow of the drill through a matching hole in the dolly. The air in the crowding chamber then blows through the hole in the crowding piston, blasting clean the bore of the drill. Except in the most aggravated cases, the duration of the entire operation is reported to be a matter of seconds only.

As may be gleaned from the accompanying illustration, the Schiffner hollow drill-steel cleaner is of simple and sturdy construction and requires a minimum of floor space. At operations where a large number of drills are in use daily, the described device will prove a valuable adjunct to the drill-sharpening shop.

New Magnetic Disk Brake Of Simple Design

• Five sizes of a new magnetic disk brake, known as the Stearns high-duty Style "DS," are now being produced by the Magnetic Manufacturing Company, Milwaukee, Wis. They range from 10 to 90 foot-pounds torque, for continuous-duty operation. The new disk brake is said to be simple in design and construction and with a minimum of moving and wearing parts. Outstanding features include manual release, a lining-wear indicator, provision of constant torque at all times (this not being subject to variations from lining wear), simplicity of adjustments for torque and lining wear, and ease of replacement of the linings when necessary.

Two Low-pressure Cylinders Feature New Compressor

• Among the new features said to be incorporated in the design of a line of three-cylinder air compressors recently introduced by Gardner-Denver Company, Quincy, Ill., is the use of two small low-pressure cylinders instead of one large cylinder. This results in lower air temperature, with corresponding saving in horsepower. The cylinder walls are water-cooled. Together with the two-stage construction employed and the use of an intercooler this is said to assure sustained high efficiency. Capacity ranges from 113 to 194 cu.ft.

Strong Seam Provided in Paper Bag For Tamping Cartridge

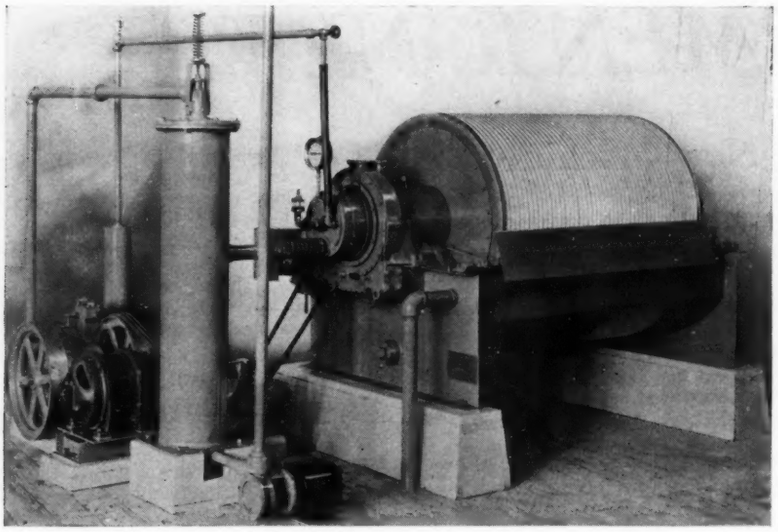
• The "Seal-Tite" paper bag of the Tamping Bag Company, Mount Vernon, Ill., was a feature of the exhibit of the Flood City Brass & Electric Company, Johnstown, Pa., at the recent meeting of the American Mining Congress in Cincinnati. The feature of this bag, which is intended to hold tamping, is said to be a seam which will not open in the presence of moisture. In fact, it is stated that the paper itself will give way before the seam.

Capacity-Weight Ratio Increased In New Grab Bucket

• A grab bucket said to be exceptional in its relation of capacity to weight has been developed by Robins Conveying Belt Company, 15 Park Row, New York. It has special shells of a shape intermediate between flat and round, thereby securing the advantages of both. Its low height and extra width, combined with a low center of gravity, are said to reduce the amount of headroom required in a vessel or car and to give greater stability when on a pile. The rope reeve is without reverse bends, and rapid opening and closing are insured by use of a three-part purchase.

Explosives and Detonators Improved For Seismic Prospecting

• To satisfy the highly specific requirements of seismic work in geophysical prospecting, the Du Pont company has developed special explosives and electric blasting caps, according to G. H. Loving and G. H. Smith, of the company's Eastern Laboratory, at Gibbstown, N. J. The most economical explosive for such work is said to have proved to be a 60 per cent ammonia gelatin. This is very water-resistant and has desirable strength and velocity characteristics. Three different gradations of it have been developed by the



This small vacuum filtering unit requires a small motor to operate it. Use of arc-welded steel plate in fabrication has greatly decreased the total weight

company for the work mentioned—namely, Seismogel A, Seismogel B, and 60 per cent special gelatin. The first is very hard and hand-packed for unusually severe loading conditions. The second is a firm gelatin well suited to the usual type of work. The third is very plastic and cohesive and is designed for work which demands a product of this type.

For shots that are to be made in water-filled holes 200 ft. or more in depth, an explosive known as 60 per cent Hi-Velocity gelatin is available. This has the ability to detonate at full strength under water pressures which would affect adversely the usual gelatin dynamites. These four types are said to have identical explosive properties in speed and strength.

Blasting caps used to detonate charges in seismographic work must satisfy certain precise limitations as to speed and uniformity of detonation. These characteristics play an important part in the accuracy of the time-distance measurements to be made. For this reason, therefore, the laboratory has conducted a comprehensive program to determine the speed characteristics of various detonating compounds. In the course of this the cathode-ray oscillograph has been used to measure the small time intervals. As a result, the seismograph electric blasting cap has been progressively improved, and recently a new detonator has been used. This is known as the "SSS" type, and is said to possess qualifications far exceeding those now needed in exploration work.

Rubber-Lined Sheaves Unaffected By Weather

• Smooth operation and dependability resulting in savings on rope and power with a low maintenance cost are claimed for the Murray-Cornish rubber-faced rollers and sheaves, recently announced by the D. J. Murray Manufacturing Company, Wausau, Wis. This equipment is intended for service wherever wire cable is used. The sheave illustrated is fitted with anti-friction bushings so that the least amount of power is required to turn it over. At the same time no slippage of the rope on the face of the sheave occurs to cause wear when the rope is stopped or reversed.

A Small Drum Filter For Small Mills

• Modern methods of construction have now made it possible to manufacture drum filters, together with the necessary accessory equipment, so that the whole assembled filter unit is more compact, considerably lighter, and much cheaper. The new Oliver metallurgical filter is said to be a good example of this. In a floor space of only 8x11 ft., the manufacturer, Oliver United Filters, Inc., has assembled the 3x4 Oliver continuous filter, together with a receiver, moisture trap, and vacuum pump. A small motor drives the filter and vacuum pump. A fractional horsepower motor drives the small centrifugal pump for handling the solution or water from the receiver.

New Globe and Angle Valves Can Interchange Parts

• Renewable bronze angle and globe valves in a new line have been placed on the market by the Fairbanks Company, 393 Lafayette St., New York, which points out the following features: a radial seat between body and bonnet insures a tight joint and perfect alignment of all parts, thus decreasing wear (this seat is drawn to a tight joint by the union nut without sliding or scraping, increasing valve life and assuring a tight body joint after every assembly); a disk ring of long-fiber asbestos compounded with vulcanizing elements and specially cured serves efficiently not only for the control of steam but also hot and cold water; the disk holder is made with standard dimensions, thus allowing use of other makes of disk rings, if desired; the rolled-rod bronze stem has at least five threads always in contact with the bonnet; a heavy bronze union nut with large hexes provides a firm wrench grip and permits removal of bonnet with less risk of damage; a protected top seat above the stem threads gives greater assurance of a clean, tight joint when the valve is fully open for repacking under pressure; and a ventilated malleable-iron handwheel affords a firm, cool grip. All parts of the globe and angle valves, it is asserted, are interchangeable.

Right-Angle Tool Attachments Facilitate Machine Repairs

• A line of tool attachments for facilitating machine repairs where the job is in a place that is hard to get at has been developed by C. A. Koza, 464 Augustine St., Rochester, N. Y. These attachments are intended for those narrow spaces and close corners where, without them, much time would be required to dismantle the machine either wholly or in part, merely to put in a hole or drill out some broken part. They may be had for such operations as drilling, boring, lining, filing, slotting, sawing, reaming, milling and others.

Variable-Speed Transmission Improved

• One of the newest combinations of a constant-speed motor, a variable-speed device, and a gear case in one unit has been announced by the United States Electrical Manufacturing Company, Los Angeles, Calif. Space has thus been saved, in addition to the economy effected due to eliminating the mounting bases and transmissions, such as couplings, fans, and belts. The unit is known as the Varidrive motor. The speed change is obtained by a micro-speed control, which varies the effective driving diameter of disks which expand and contract for higher and lower speeds, transmitting power through a belt to the take-off shaft.

Large-Capacity Trailer Cars For Bulk Materials

• A line of trailer cars (in 8- to 25-ton sizes) for handling coal, ore, rock, dirt, or other materials of heavy weight and bulk has been announced by the Austin-Western Road Machinery Company, Aurora, Ill. Engineered for maximum pay-load operation, these cars (on rubber tires) have features similar to those employed by recognized builders of railroad dump cars. They are equipped with bottom- or side-dump doors that operate by air, hydraulic, or mechanical (manual) controls, and come in three standard body designs. Features include a full universal, gravity-cushioned fifth wheel for rough surface travel without strain or distortion; generous ground clearance for easy dumping; low overall height for quick, convenient loading; dumping controlled by truck driver from cab; and short turning radius with ample clearance.

Valve Wheels Colored To Indicate Use

• To facilitate the instant recognition of valves, Jenkins Brothers have developed a new type of valve wheel which is molded of colored plastic materials. Five standard colors—blue, red, black, green, and gray—are used unmarked, also these colors with five standard service markings molded in relief. The wheels can also be made up with a special color or with special markings to suit the conditions under which the installation is made or to meet the customer's whim.

All Arcking Contacts in Oil In These Starters

• A new line of oil-immersed magnetic starters of the reduced-voltage, auto-transformer type, in which all arcking contacts are 6 in. under oil, has been developed by the General Electric Company. An induction-type temperature overload relay is used, also mounted in the oil. Either current-limit or time-limit acceleration is available, and an ammeter attachment can be supplied if desired. Ratings range upward to 600 amp. at 600 volts and 200 amp. at 2,500 volts.

Impact Wrench Now Made Reversible

• The Pott impact wrench, made by Ingersoll-Rand Company, New York, and already described in the February issue of this magazine, can now be supplied with a reversible mechanism, so that it can be used for both applying and removing nuts. The reversing is accomplished by shifting gears instead of reversing the air motor. This method was adopted because a non-reversible multivane motor uses about one-third less air than a reversible motor of comparative size. It also prevents accidental reversing, thus adding to the safety of the wrench. Without the chuck, the wrench weighs 23½ lb. Another new feature is the air cooling of the accumulator, which prevents overheating and gives longer life. As previously described, this new wrench runs nuts on or off at a speed of approximately 600 to 700 r.p.m. and 1,200 to 1,400 impacts per minute, tightening or loosening.

New Mining Cable Built To Resist Abrasion

• A new cable with loom-woven sheath, for use on reel locomotives and other applications where severe mechanical abrasion must be withstood, is now available from General Electric. Its finish consists of a circular-loom-woven sheath, applied in a manner similar to the weaving of a carpet. Under this sheath is a layer of Glyptal cement, the sheath being so applied that it is embedded in the cement and partly embedded in the rubber insulation. This results in a cable that is tough, extremely resistant to abrasion, and, because of the cement, highly resistant to oil, alkali, and acid.

Drilling Rig Designed For Remote Jobs

• Light weight and ruggedness are typical features of the completely demountable drilling rig known as the Airplane placer drill, which is being introduced into the Territory of Alaska by C. Kirk Hillman Company, Seattle, Wash. It is advocated for drilling where rapid work is wanted in remote localities. It is said to be capable of testing to bedrock regardless of water, boulders, or frozen ground. The drill is operated by gasoline, using only two gallons per day. It strikes approximately fifty blows a minute, with a 300- or 400-lb. string of tools and a 28-in. stroke. The stroke is adjustable within a range of 15 to 30 in. Capacity for drilling, driving, and pulling is approximately 200 ft. The heaviest piece weighs 150 lb. and the longest is 6½ ft. long. Without its 3-hp. engine weighing 260 lb., the total weight is 1,000 lb. The height of the derrick above the drill frame is 13 ft.

New Sinker Drill Light And Economical

• A light sinker in two models for wet and dry drilling respectively (Models CP-22 and CP-22W) has been introduced by Chicago Pneumatic Tool Company, New York. Net weight of the dry model is 28 lb.; that of the wet drill 32 lb. Over-all length is 19⅞ in. and the economical drilling depth 6 to 8 ft. The new machine takes a ⅞x3½-in. hex. drill steel shank, a ¾-in. air hose, and a ½-in. water hose. The maker claims exceptional drilling speed for it, as well as rotative strength.

Industrial Notes

• Dow Chemical Company, of Midland, Mich., and the Cleveland-Cliffs Iron Company, of Cleveland, have organized the Cliffs-Dow Chemical Company. Cleveland-Cliffs has owned and operated a chemical plant at Marquette, Mich., for 30 years. The new company will manufacture chemicals derived from wood, a field in which both companies have been experimenting and carrying on research work. Willard Dow is president.

• Smith-Emery Company, industrial chemists and engineers of Los Angeles, are celebrating the completion of their 25th year of continuous operation in that city. Established in 1910 with a staff of four members, the company has gradually enlarged the scope of its activities in pace with the industrial growth of southern California. It has representatives at San Francisco, Portland, and Seattle, and is associated with the Pittsburgh Testing Laboratories.

Bulletins

Detachable Rock-Bit Grinder. C. H. Carlson Mfg. Co., 13 Main St., N.E. Minneapolis, Minn. Folder. Pp. 4.

Dredge Bucket Pins. Hadfields Ltd., Sheffield, England. Bulletin No. 374. The Blackie self-locking pin. Pp. 4.

Conveyor Idler. Link-Belt Co., Chicago. Folder 1408. Positive self-aligning idler for troughed conveyor belts. Pp. 6.

Centrifugal Side-suction Pumps. Gardner-Denver Co., Quincy, Ill. Bulletin CP11. Pp. 16.

Power Jack. Blackhawk Mfg. Co., Milwaukee, Wis. Booklet on the "Porto-Power" jack. Pp. 24.

M.S.A. Safety Signs. Mine Safety Appliances Co., Pittsburgh, Pa. Bulletin CD-1. Porcelain enameled signs. Pp. 4.

Diamond Drills and Drilling Equipment. E. J. Longyear Co., Minneapolis, Minn. Bulletins 39, 41, 42, and 43 on various models of diamond-core drills. Bulletin 45, on the Rotacore drill, combining rotary table drive and hydraulic feed. Bulletin 46, on an improved core splitter. Bulletin 47 on core barrels.

Anti-friction Bearing Mountings. Bearing Appliance Co., Ardmore, Pa. Bulletin B, on standard appliances. Pp. 12.

Welding Clamps. Key-Bolt Appliance Co., Elmira, N. Y. Bulletin on clamps for lap and butt welding. Pp. 4.

Welding Electrodes. Metal & Thermit Corporation, New York. Bulletin on Murex heavy-mineral coated electrodes. Pp. 16.

Pneumatic Tools. Independent Pneumatic Tool Co., 600 West Jackson Blvd., Chicago, Catalog 50.

Tapes, Rules, Micrometers, and Precision Tools. The Lufkin Rule Co., Saginaw, Mich., General Catalog, No. 12, Pp. 256.

Chromated Zinc Chloride. Grasselli Chemical Co., Cleveland, Ohio. Bulletin on wood preservative. Pp. 14.

Jig for Placer Sands. A.B.T. Jig Co., 2301 Fifteenth St., Denver, Colo. Pp. 4.

Drop Forgings. Kropp Forge Co., 5301 W. Roosevelt Road, Chicago, Pp. 4.

High-Temperature Bonding Mortars Harbison-Walker Refractories Co., 1301 Farmers Bank Bldg., Pittsburgh, Pa. Three folders covering Thermolith, Firebond, and Harwaco Bond respectively.

Cable. General Cable Corp., New York. Leaflet on Mid-Rip separating flexible lamp cord. Also Bulletin WP-1 on Peerless weather-proof wires and cables.

Chain and Belt Conveying. Chain Belt Co., Milwaukee, Wis. Bulletin No. 260. Pp. 14.

Roller Bearings. Timken Roller Bearing Co., Canton, Ohio. "The Timken Engineering Journal," Third Edition. This 260-page, loose-leaf (8½x11 in.), indexed data book contains a description of the various types of Timken bearings, as well as technical data on ratings, load calculations, bearing selection, and other information pertinent to the mounting, use, and maintenance of Timken bearings. It has been compiled for the use of engineers and machine designers. It is bound in a stiff loose-leaf binder.

Horizontal Duplex Piston Pumps. Worthington Pump & Machinery Corp., Harrison, N. J. Folder W-102-B1. Type B turret type. Pp. 6.

Double-suction Centrifugal Pumps. Gardner-Denver Co., Quincy, Ill. Pp. 4.

Flotation. Pan-American Engineering Corporation, San Francisco. Kraut machine. Pp. 6.

Cable Accessories. General Electric Co., Schenectady, N. Y. Bulletin GEA-1839. Pp. 78.

Steam-driven Compressors. Ingersoll-Rand Co., New York. XPV compressors. Pp. 48.

Aerial Wire Rope Tramways. American Steel & Wire Co., New York. Catalog. Pp. 108.

Vibrating Device for Screens. Ajax Flexible Coupling Co., Westfield, N. Y. Bulletin on Shaler shaker. Pp. 4.

Portable Belt Conveyors. Link-Belt Co., Chicago. Folder No. 1414. Pp. 4.

Explosives. E. I. du Pont de Nemours & Co., Wilmington, Del. Du Pont Explosives Service Bulletin on Nitramon, a blasting agent for large-diameter drill holes. Pp. 4.

Centrifugal Pumps. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin W-323-B3. Self-priming centrifugal Monobloc pumping units. Pp. 4.

Twist Drills. Edgar Allen & Co., Ltd. Imperial Steel Works, Sheffield, England. Bulletin 1019. Pp. 8.

Mine Pumps, Incline and Vertical. Byron Jackson Co., Berkeley, Calif. Bulletin 359. Pp. 12.

Rubber Belting, Hose and Other Products. Raybestos-Manhattan, Inc., Passaic, N. J. General Catalog of Manhattan Rubber Manufacturing Division. Pp. 56.

Pyranol Capacitors. General Electric Co., Schenectady, N. Y. Bulletin GEA-77H. Pp. 26.

Compounds for Insulating and Sheathing Cable. General Electric Co., Schenectady, N. Y. Bulletin GEA-2113. Pp. 12.

Transmission Appliances. SKF Industries, Inc., Philadelphia, Pa. Bulletin 217A. Pp. 12.

Cable. General Cable Corporation, New York, Bulletin "Advance in Design, Paper-insulated Power Cables." Pp. 14.

Stainless Steels Treated With Columbium. Electro Metallurgical Co., New York. Bulletin. Pp. 4.

Petrographic Equipment. Carborundum Co., Niagara Falls, N. Y. Folder on diamond wheels for the preparation of petrographic thin sections. Pp. 6.

Aërial Wire Rope Tramways. American Steel & Wire Co., New York. Descriptive bulletin Pp. 105.

Diamond Drills. Sullivan Machinery Co., Chicago. Bulletin 90-A: No. 22 diamond core drill. Pp. 8.

Drill Sharpening. Ingersoll-Rand Co., New York. Bulletin 2176, covering the new IR-54 sharpener and the 7 F and 27 F low-pressure oil furnaces. Pp. 4.

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

STRENUOUS efforts to save the marketing structure under which the domestic copper industry had made much progress during the last year came to nothing. The best talent that the industry could assemble found no way legally to prolong the agreement. The skeletonized NRA, signed by President Roosevelt June 14, made it clear that the anti-trust laws were again in full force. Fabricators and producers were released from further participation in the plan, and shortly thereafter selling was resumed in a free and open market.

The price did not weaken until June 21, on which date sales were reported to *Engineering and Mining Journal* as low as 8c., Valley, a full cent under the quotation that held for about a year. Inasmuch as a good tonnage was moved on the same day at 9c., our weighted average quotation naturally was nearer the 9c. level. Early on June 27, however, all important sellers reduced their quotation to 8c., Valley, which price held up to the close of the month.

The next move in copper, according to trade authorities, will be in the direction of holding production in check here and convincing foreign producers that the ending of NRA should not endanger the international control plan. The decline in the price, it was generally believed, will remind all concerned that some measure of restriction in output is necessary.

Buying of all major non-ferrous metals suffered because of the uncertainty over the copper situation. Fabricators, on the other hand, said that the movement of finished products into consumption has not diminished greatly. Zinc held about unchanged in price during the last month.

Stocks of copper, lead, and zinc in the United States at the end of January and May, of the current year, in short tons, were as follows:

	Jan. 1935	May 1935
Copper *(a)*	339,250	279,000
Lead, refined	231,928	225,057
Zinc	119,906	107,625

(a) Includes stocks held for account of fabricators, etc.

Aluminum quotations remained more or less nominal at 19@21c. per pound. Quicksilver was offered more freely at lower prices. Antimony, domestic, was maintained at 12½c., spot, throughout the month, or about one-quarter cent under the Chinese material, duty paid.

Silver suffered a net loss in the open market of 4¾c. per ounce. Speculators were the principal sellers on continued uncertainty over the future of the United States program.

The *E.&M.J.* index of non-ferrous metal prices for June was 79.57, against 80.50 in May and 74.73 in April.

United States Market

1935 June	Electrolytic Copper Domestic (a)	Electrolytic Copper Export (b)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
1	8.775	7.890	51.600	4.25	4.10	4.30
3	8.775	7.675	51.250	4.10	3.95	4.30
4	8.775	7.550	51.100	4.10	3.95	4.30
5	8.775	7.675	51.150	4.00@4.10	3.85@3.95	4.30
6	8.775	7.625	50.950	4.00	3.85	4.30
7	8.775	7.450	50.600	4.00	3.85	4.30
8	8.775	7.500	50.400	4.00	3.85	4.30
10	8.775	7.425	50.500	4.00	3.85	4.30
11	8.775	7.425	50.550	4.00	3.85	4.25@4.30
12	8.775	7.400	50.875	4.00	3.85	4.30
13	8.775	7.350	51.250	4.00	3.85	4.30
14	8.775	7.375	51.275	4.00	3.85	4.30
15	8.775	7.325	51.250	4.00	3.85	4.30
17	8.775	7.325	50.800	4.00	3.85	4.30
18	8.775	7.175	51.100	4.00	3.85	4.30
19	8.775	7.175	51.150	4.00	3.85	4.30
20	8.775	7.075	51.000	4.00	3.85	4.30
21	8.500	7.050	51.000	4.00	3.85	4.30
22	8.775	7.075	50.950	4.00	3.85	4.30
24	8.775	7.100	51.000	4.00	3.85	4.30
25	8.525	7.175	51.200	4.00	3.85	4.30
26	8.775	7.050	51.500	4.00	3.85	4.30
27	7.775	6.975	51.750	4.00	3.85	4.30
28	7.775	6.950	51.750	4.00	3.85	4.30
29	7.775	6.975	51.750	4.00	3.85	4.30
Av. for month	8.634	7.307	51.108	4.020	3.870	4.299
Averages for Week						
5	8.775	7.742	51.340	4.15	4.00	4.300
12	8.775	7.471	50.646	4.00	3.85	4.296
19	8.775	7.288	51.138	4.00	3.85	4.300
26	8.688	7.088	51.108	4.00	3.85	4.300
Calendar Week Averages						
1	8.775	7.963	51.645	4.310	4.160	4.300
8	8.775	7.579	50.908	4.042	3.382	4.300
15	8.775	7.383	50.950	4.000	3.850	4.296
22	8.729	7.146	51.000	4.000	3.850	4.300
29	8.233	7.038	51.492	4.000	3.850	4.300

Silver, Gold, and Sterling Exchange New York and London

1935 June	Sterling Exchange "Checks"	Sterling Exchange "90-day Demand"	Silver (c) New York	Silver (c) London	Gold London	Gold (d) United States
1	4.91000	4.88750	74.000	33.7500	142s	$35.00
3	4.91250	4.89125	73.875	33.5000	142s	35.00
4	4.92250	4.90250	72.500	32.5000	141s11d	35.00
5	4.94250	4.92000	72.500	33.0625	141s 2½d	35.00
6	4.94250	4.92000	72.250	32.5000	140s 7 d	35.00
7	4.93000	4.91250	72.250	32.6875	141s 9½d	35.00
8	4.91875	4.89875	72.500	32.6875	141s10 d	35.00
10	4.92250	4.90250	73.375	Holiday		35.00
11	4.92500	4.90500	73.000	33.1875	141s10 d	35.00
12	4.93875	4.91750	72.875	32.8125	140s 9 d	35.00
13	4.93750	4.91750	72.625	32.8125	140s10 d	35.00
14	4.93750	4.91875	72.875	32.8125	140s 8 d	35.00
15	4.93625	4.91750	72.875	32.8750	140s 9 d	35.00
17	4.92375	4.90125	72.500	32.6250	141s 2 d	35.00
18	4.92500	4.90875	72.500	32.6875	141s 2 d	35.00
19	4.93625	4.91875	72.000	32.1875	140s11½d	35.00
20	4.93000	4.91250	72.000	32.3125	141s 1½d	35.00
21	4.93250	4.91500	72.000	32.1250	141s 2½d	35.00
22	4.93750	4.92000	72.000	32.3125	141s 1 d	35.00
24	4.94000	4.92250	70.250	31.5000	140s11½d	35.00
25	4.94750	4.93000	69.500	31.0625	141s ½d	35.00
26	4.94000	4.92250	69.500	31.0000	141s 2 d	35.00
27	4.93750	4.91875	69.500	31.0625	141s 3½d	35.00
28	4.94500	4.92875	69.500	31.0000	141s 3½d	35.00
29	4.94000	4.92750	69.750	31.2500	141s 4½d	35.00
Av. for month	4.93245	.....	71.940	32.346	.....	35.00
Averages for Week						
5	4.92600	.....	73.475	.....	.....	.....
12	4.92958	.....	72.708	.....	.....	.....
19	4.93271	.....	72.563	.....	.....	.....
26	4.93792	.....	70.875	.....	.....	.....

Calendar week averages: New York Silver June 1st, 74.225; 8th, 72.646; 15th, 72.938; 22nd, 72.167; 29th, 69.667.

The above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis, add 0.225c. per pound, the average differential for freight and interest charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.300c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order issued April 24, 1935, the U. S. Government's price on newly mined domestic silver was established at 77.57.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

June	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic Bid	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
3	31.8750	32.2500	35.5000	228.2500	222.0000	14.0000	14.1250	13.8125	14.1250
4	31.8125	32.1875	35.0000	226.7500	221.2500	13.6875	13.8125	14.0000	14.3125
5	32.5625	32.8750	36.0000	226.0000	220.5000	13.9375	13.9375	14.0000	14.2500
6	32.1875	32.5625	35.7500	225.7500	220.5000	13.9375	13.9375	13.6875	14.0000
7	31.6250	32.0000	35.0000	223.0000	218.0000	13.7500	13.6875	13.5625	13.8750
10					Holiday				
11	31.7500	32.1250	35.0000	223.5000	217.1250	13.7500	13.6875	13.6250	13.8125
12	31.9375	32.3125	35.2500	224.2500	218.5000	14.0000	14.0000	14.0000	14.1875
13	31.4375	31.7500	34.5000	226.2500	220.5000	13.8125	13.8125	13.8125	14.0000
14	31.6250	32.0000	34.7500	226.7500	220.7500	13.8125	13.8125	13.8125	13.9375
17	31.1250	31.5000	34.0000	227.0000	219.5000	13.6875	13.7500	13.7500	13.8750
18	30.1875	30.5625	33.5000	228.5000	216.2500	13.4375	13.5000	13.3750	13.5000
19	30.1250	30.5000	33.5000	229.5000	217.2500	13.5625	13.5625	13.1875	13.3125
20	29.8125	30.1875	33.0000	229.7500	217.7500	13.6875	13.6875	13.2500	13.3750
21	29.6875	30.0625	32.7500	229.8750	218.5000	13.7500	13.7500	13.4375	13.5625
24	30.5625	30.9375	33.7500	229.7500	219.2500	13.9375	14.0000	13.8750	14.0000
25	30.0000	30.4375	33.0000	229.7500	219.7500	13.8750	13.9375	14.0000	14.0625
26	29.2500	29.5625	32.5000	229.7500	220.2500	13.6875	13.7500	13.8750	13.9375
27	28.7500	29.1875	32.0000	229.8750	220.5000	13.6875	13.7500	13.8750	13.9375
28	28.8750	29.3125	32.0000	229.8750	220.7500	13.7500	13.8125	14.0000	14.0000
Av. for month	30.799	.....	34.039	227.586	.....	13.776	13.806	13.734	13.898

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(July 1, 1935)

Miscellaneous Metals

Aluminum, ingot, 99 per cent plus, lb.	19@21c.
Antimony, domestic or Chinese (duty paid), lb.	12½c.
Bismuth, ton lots, lb.	$1.10
Cadmium, lb.	65.00c.
Chromium, 97 per cent grade, lb.	88.00c
Nickel, electrolytic cathodes, lb.	35.00c.
Magnesium, 99.8 per cent, carloads, lb.	30.00c.
Palladium, troy oz.	$24.00
Platinum, (official quotation) troy oz.	$32.00
Quicksilver, flask of 76 lb., 100 flasks or more.	$71.00
Radium, mg. radium content	$50.00
Selenium, 99.5 per cent, lb.	$2.00
Silicon, minimum 97 per cent, spot, lb.	16.50c.
Tellurium, lb.	$2.00
Thallium, 100 lb. or more, lb.	$6.50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton	$15.50@$16.50
Iron Ore, Lake Superior, long ton:	
Old Range bessemer	$4.80
Mesabi, bessemer	$4.65
Old Range, non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent, Joplin, Mo., ton	$38.00
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52@55 per cent.	26c.
49@51 per cent.	25c.
44@47 per cent.	24c.
Molybdenum Ore, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$15.00
Domestic Scheelite	$14.50
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$28.00

Metallic Compounds

Arsenious Oxide (arsenic) lb.	3½c.
Cobalt Oxide, 70@71 per cent, lb.	$1.35
Copper Sulphate, 100 lb.	$3.85
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb.	$1.24
Sodium Sulphate, bulk, ton.	$13.00@$15.00

Alloys

Beryllium-Copper, Master alloy, 3.5 per cent Be, per lb. of contained Be.	$25.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb.	10c.
Ferromanganese, 78@82 per cent, gross ton.	$85.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained.	95c.
Ferrosilicon, 50 per cent, gross ton.	$77.50
Ferrotungsten, 75@80 per cent, lb. of W contained.	$1.35@$1.45

Non-Metallic Minerals

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$500@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$135
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$45@.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 95 per cent $BaSO_4$, less than 1 per cent iron	$5.50
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a) $4.50@ $6.00
French, 56@59 per cent	(a) $5.50@ $6.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$6.00@ $7.50
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.50
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	$13.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½x2 in.	15@30c.
2x2 in.	30@50c.
2x3 in.	50@65c.
3x4 in.	90@ $1.25
4x6 in.	$1.50@ $2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@ 12½c.
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$16.00@.....
200 mesh, cream colored	$26.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$19.00
Basic	$18.00
No. 2 Foundry	$18.50
Steel, base prices, Pittsburgh:	
Billets gross ton	$27.00
Structural shapes, 100 lb.	$1.80
Bars, 100 lb.	$1.80

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1934	1935	1934	1935	1934	1935
January	44.188	54.418	19.382	24.584	504.644	489.207
February	45.233	54.602	20.073	24.818	503.085	487.278
March	45.875	59.048	20.278	27.380	509.259	477.635
April	45.180	67.788	19.740	30.986	515.210	483.596
May	44.226	74.356	19.276	33.865	510.510	488.587
June	45.173	71.940	19.981	32.346	504.721	493.245
July	46.310	.....	20.512	.....	503.990	.....
August	48.986	.....	21.377	.....	506.398	.....
September	49.484	.....	21.888	.....	499.344	.....
October	52.375	.....	23.581	.....	494.019	.....
November	54.255	.....	24.257	.....	498.832	.....
December	54.390	.....	24.404	.....	494.520	.....
Year	47.973	.....	21.229	.....	503.711	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery, Electrolytic			London Spot			
	Domestic		Export	Standard		(a) Electrolytic	
	1934	1935	1935	1934	1935	1934	1935
January	7.890	8.775	6.583	32.560	28.077	35.614	31.261
February	7.777	8.775	6.341	33.072	27.175	35.969	30.244
March	7.775	8.775	6.526	32.497	28.518	35.512	31.607
April	8.173	8.775	7.328	33.006	31.231	36.038	34.763
May	8.275	8.775	7.794	32.662	33.344	35.756	36.733
June	8.594	8.634	7.307	32.149	30.799	35.339	34.039
July	8.775	.....	.....	29.707	.....	32.778	.....
August	8.775	.....	.....	28.358	.....	31.483	.....
September	8.775	.....	.....	27.541	.....	30.556	.....
October	8.775	.....	.....	26.753	.....	29.478	.....
November	8.775	.....	.....	27.233	.....	30.222	.....
December	8.775	.....	.....	27.836	.....	31.086	.....
Year	8.428	.....	.....	30.281	.....	33.319	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

Lead

	New York		St. Louis		London			
	1934	1935	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.000	3.692	3.900	3.542	11.304	11.517	10.321	10.514
February	4.000	3.528	3.900	3.378	11.634	11.913	10.216	10.413
March	4.000	3.579	3.900	3.429	11.545	11.842	11.012	11.188
April	4.179	3.692	4.042	3.542	11.500	11.794	12.231	12.459
May	4.140	3.962	3.990	3.812	11.051	11.341	13.861	13.940
June	3.975	4.020	3.825	3.870	11.054	11.253	13.776	13.806
July	3.772	.....	3.623	.....	10.813	11.045	.....	.....
August	3.747	.....	3.597	.....	10.821	11.028	.....	.....
September	3.685	.....	3.535	.....	10.388	10.613	.....	.....
October	3.654	.....	3.504	.....	10.359	10.554	.....	.....
November	3.567	.....	3.417	.....	10.432	10.597	.....	.....
December	3.604	.....	3.454	.....	10.316	10.500	.....	.....
Year	3.860	.....	3.724	.....	10.935	11.166	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	Straits New York		Standard, Spot London	
	1934	1935	1934	1935
anuary	51.891	50.916	226.631	231.193
February	51.668	50.063	226.731	227.381
March	53.838	46.962	233.863	215.726
April	55.622	50.154	239.181	223.513
May	53.541	51.138	234.239	227.602
June	51.271	51.108	226.875	227.586
July	51.930	.....	230.381	.....
August	51.953	.....	228.114	.....
September	51.503	.....	229.888	.....
October	50.951	.....	230.587	.....
November	51.227	.....	228.602	.....
December	50.902	.....	228.178	.....
Year	52.191	.....	230.273	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.271	3.730	14.688	14.943	11.994	12.207
February	4.384	3.714	14.844	15.125	11.819	12.000
March	4.368	3.894	14.735	15.033	12.095	12.250
April	4.370	4.030	14.916	15.200	12.891	13.128
May	4.346	4.220	14.722	14.966	14.534	14.685
June	4.240	4.299	14.241	14.467	13.734	13.898
July	4.317	.....	13.466	13.693	.....	.....
August	4.281	.....	13.682	13.756	.....	.....
September	4.049	.....	12.644	12.847	.....	.....
October	3.832	.....	12.217	12.353	.....	.....
November	3.732	.....	12.000	12.281	.....	.....
December	3.711	.....	11.730	12.016	.....	.....
Year	4.158	.....	13.657	13.890	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1934	1935	(a) 1934	(b) 1935
January	55.000	55.000	23.300	20.000
February	55.000	55.000	23.300	20.000
March	55.000	58.462	23.300	20.000
April	55.000	65.000	23.300	20.000
May	55.000	65.000	23.300	20.000
June	55.000	65.000	23.300	20.000
July	55.000	.....	23.300	.....
August	55.000	.....	23.300	.....
September	55.000	.....	23.300	.....
October	55.000	.....	23.300	.....
November	55.000	.....	23.300	.....
December	55.000	.....	23.300	.....
Year	55.000	.....	23.300	.....

Aluminum in cents per pound, 99 per cent grade. (a) Based on Aluminum Company's quotation. (b) Open market price.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1934	1935	1934	1935	1934	1935
January	7.198	14.111	67.538	72.760	38.000	34.000
February	7.172	14.250	72.011	72.500	38.000	34.000
March	7.545	14.250	75.472	72.500	38.000	32.846
April	7.918	14.029	75.930	72.500	38.000	32.000
May	8.465	12.712	75.577	72.135	36.538	32.000
June	7.900	12.500	75.000	71.460	36.000	32.000
July	8.024	.....	75.000	.....	36.000	.....
August	8.514	.....	75.000	.....	36.000	.....
September	8.745	.....	74.563	.....	36.000	.....
October	9.361	.....	74.000	.....	35.038	.....
November	12.239	.....	73.283	.....	35.000	.....
December	13.730	.....	73.000	.....	35.000	.....
Year	8.901	.....	73.865	.....	36.465	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1934	1935	1934	1935	1934	1935
January	18.00	19.00	17.00	18.00	17.50	18.50
February	18.00	19.00	17.00	18.00	17.50	18.50
March	18.00	19.00	17.00	18.00	17.50	18.50
April	18.48	19.00	17.48	18.00	17.98	18.50
May	19.00	19.00	18.00	18.00	18.50	18.50
June	19.00	19.00	18.00	18.00	18.50	18.50
July	19.00	.....	18.00	.....	19.50	.....
August	19.00	.....	18.00	.....	18.50	.....
September	19.00	.....	18.00	.....	18.50	.....
October	19.00	.....	18.00	.....	18.50	.....
November	19.00	.....	18.00	.....	18.50	.....
December	19.00	.....	18.00	.....	18.50	.....
Year	18.707	.....	17.707	.....	18.207	.....

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces.

H. C. PARMELEE
Editorial Director

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•

Prospectus. We quote from an invitation to participate in a bonanza: "We found pure gold massive, not in rock but solid, in the mountain rivers. So it is clear that in places higher up the mines are so full that some give away their gold contents in readily saleable gold. The first cuttings may have some gold-bearing stones, but once inside, pure gold must exist." We were admonished to bring a mining engineer "who can perfectly tell the truth, not giving a statement that there is no gold there, as no engineer can fool me in that way."

•

A Family Enterprise is the copper mine in Dalecarlia, Sweden. According to the United Press, it is owned by the oldest chartered concern in the world, having been controlled by one family since the year 1220. Excavations are reported to be in such vast volume that the Cheops Pyramid might be contained therein. This is evidently a "permanent camp."

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South African Gold Mines employed 244,100 native workers and 27,600 white employees in 1934. Wages totaled £18,750,000 and taxes paid were more than £13,000,000—much of this huge sum being "plowed under" in other economic activity than gold mining, chiefly agriculture. South Africa bought from England £4,000,000 worth of machinery in 1934—double the 1932 importation. Three-fifths of the world's gold output is still produced within the British Empire. Fortunately for the rest of the world, and for Great Britain itself, all of it does not remain permanently within the Empire.

•

Waste Conscious. A campaign to eliminate or reduce the amount of waste represented in the average scrap pile was inaugurated recently at a meeting of the A.S.M.E. in Cincinnati. T. H. Owens of the Westinghouse Co. described the measures taken in his organization to salvage many items in every-day use around the plant. No waste is accepted as unavoidable and every effort is made to dry up its source. Analysis of contents of the scrap pile will suggest many things that might be done to eliminate or reduce the amount of waste.

•

Congress hates to take up tax legislation as much as a small boy hates to wash his ears. It would like to put it off, but it cannot afford to make an issue of it when the budget is out of balance and when social objectives are involved. The President is in a position to secure action on his program. Adjournment would be countenanced only if it should become apparent that legislation far different from that desired is likely to be enacted.

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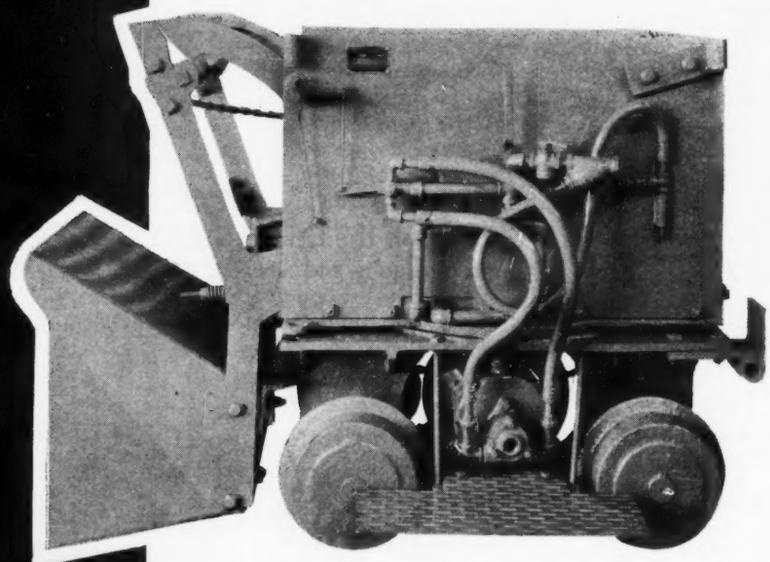

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